USER MANUAL

Building Acoustics Software
BZ-7228

for use with

Hand-held Analyzer Types 2250 and 2270

BE 1799 – 17
English

Brüel & Kjær

Building Acoustics Software BZ-7228

for use with
Hand-held Analyzer Types 2250 and 2270

Valid for all hardware versions and from software version 4.5

User Manual

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Health and Safety Considerations

This apparatus has been designed and tested in accordance with IEC/EN 61010 – 1 and ANSI/UL 61010 – 1 *Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use*. This manual contains information and warnings which must be followed to ensure safe operation and to retain the apparatus in safe condition.

Safety Symbols and Signal Words Used

The apparatus will be marked with this symbol when it is important that you refer to the associated danger or warning statement given in this manual

The manual uses this symbol when a danger or warning statement is applicable

Hazardous Voltage/Electricity. Both the apparatus and manual use this symbol when there is a risk for shock or electrocution

Hot Surface. This manual will use this symbol when there is a risk for burning or scolding

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Protective Conductor Terminal. The apparatus will be marked with this symbol when applicable

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Danger Signals an imminent hazardous situation, which, if not avoided, will result in death or serious injury

Warning Signals a possibly hazardous situation, which, if not avoided, will result in death or serious injury

Caution Signals a hazardous situation, which, if not avoided, could result in minor or moderate injury or damage to the apparatus

Notice Signals a situation or practice that requires attention, but does not directly result in personal injury if ignored

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Danger: The apparatus is not designed to be used in potentially explosive environments. It should not be operated in the presence of flammable liquids or gases

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Warning: Any adjustment, maintenance and repair of the open apparatus under voltage must be avoided as far as possible and, if unavoidable, must be carried out only by trained service

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Contents

CHAPTER 1
Introduction **1**
1.1 How to Use this Manual 1

CHAPTER 2
Building Acoustics Measurements **3**
2.1 Building Acoustics Defined 3
2.2 Measurement Procedure 6

CHAPTER 3
System Overview **15**

CHAPTER 4
Building Acoustics Software **17**
4.1 What is a Building Acoustics Project? 17
4.2 Navigating Building Acoustics Software 17
4.3 Things To Remember 24
4.4 Level Measurements (L1, L2 and B2) 25
4.5 Reverberation Time Measurements (T2) 41
4.6 Low-frequency Measurements 49
4.7 2-channel Measurements (Type 2270 Only) 53
4.8 Displaying Results 58
4.9 Quality Indicators 61
4.10 Creating a New Project 64
4.11 Reusing Data from an Existing Project 64
4.12 Annotations and Signal Recording 65
4.13 Exporting, Post-processing and Reporting 67

CHAPTER 5
Specifications **69**

APPENDIX A
Setup Parameters 81
A.1 Input (For Type 2270 Only) 82
A.2 Input 83
A.3 Standard 84
A.4 Frequency Range 84
A.5 Measurement Control L1, L2 and B2 85
A.6 Measurement Control T2 86
A.7 Signal Recording 87
A.8 Generator for L1 and L2 88
A.9 Generator for T2 89
A.10 Geometry 91
A.11 Calculations 92

APPENDIX B
Measurement Parameters 95
B.1 Building Acoustics Standards 95

INDEX 99

Chapter 1

Introduction

Building Acoustics Software BZ-7228 is an application package for Hand-held Analyzer Types 2250 and 2270. BZ-7228 is a single-channel application that can be used on Type 2250 or Type 2270. With 2-channel Option BZ-7229, Type 2270 (only) becomes a dual-channel building acoustics tool.

If you are newcomer to the world of Type 2250 or 2270, you are strongly advised to study – *Hand-held Analyzer Types 2250 and 2270 – User Manual* (BE 1713) before reading this manual because it will enable a better understanding of the platform concept and how the BZ-7228 application package fits into the portfolio. You will also become familiar with some terms used in this manual that apply to analyzers in general.

This manual provides instructions for:

- Setting up your hand-held analyzer for building acoustic measurements
- Measuring building acoustics
- Looking at your results

This manual assumes that you are familiar with the concepts of measuring sound using a microphone and some form of sound level meter/analyzer.

1.1 How to Use this Manual

1.1.1 Conventions Used in this Manual

"Analyzer" refers to Type 2250 or Type 2270 if the description is valid for both types.

Instructions and descriptions that refer to the analyzer pushbuttons are shown with the pushbutton icons as seen on the analyzer. See Chapter 2 for a list of pushbutton icons and their functions.

Icons, Buttons and Tabs Used on the Screen

Indicated by bold type face (for example, tap **Main Menu** icon).

Parameter Values, Text and Variables

Parameter values, instructions, descriptions appearing on the screen and variables are indicated by italics (for example, *Internal Disk*).

Menu, Parameters and Screen Navigation

Indicated by bold type face (for example, **Setup** > **Frequency Settings** > **BB Peak**).

Keyboard Entries

Keyboard entries and combinations are indicated by bold type face within angle brackets (for example, **<Ctrl+b>** means you should press the **Ctrl** button and **b** button at the same time).

1.1.2 Beginners

Before you read the rest of this manual, read Brüel & Kjær's primer on Measuring Sound. This will give you a basic idea of acoustic measurements. It can be found on the www.bksv.com website, by typing 'Primer' in the search window. The website also contains lots of other information you might find useful.

Further information is available in the online help installed on the analyzer.

1.1.3 Experienced Users of Acoustic Measurement Equipment

The manual is designed so that you do not have to read all of it to be able to use the analyzer. It is built around the most frequently used operations, these are as follows:

- Building Acoustics Measurements (Chapter 2)
- System Connections (Chapter 3)
- Building Acoustics Software (Chapter 4)
- Specifications (Chapter 5)
- Setup Parameters (Appendix A)
- Measurement Parameters (Appendix B)

However, it is recommended that you read the entire manual for appropriate procedures on how to use the analyzer to obtain accurate sound level measurement results.

Chapter 2

Building Acoustics Measurements

This chapter describes how to perform building acoustics measurements using:

- Type 2250 or Type 2270 with Building Acoustics Software BZ-7228 (single channel)
- Type 2270 Building Acoustics Software BZ-7228 and 2-channel Option BZ-7229

2.1 Building Acoustics Defined

Building Acoustics is the assessment of sound insulation in buildings. The assessment is based on measured 1/1-octave or 1/3-octave spectra within the 50 – 5000 Hz range.

Measurements may be serial (one frequency band at a time) or parallel (all bands simultaneously).

Please note: 'Room acoustics' is the assessment of sound quality inside a room and outside the scope of this document. It is described in *Hand-held Analyzer Types 2250 and 2270 – User Manual*, Chapter 14 – Reverberation Time Software (Optional Module).

2.1.1 Tasks

There are three kinds of building acoustics measurement tasks:

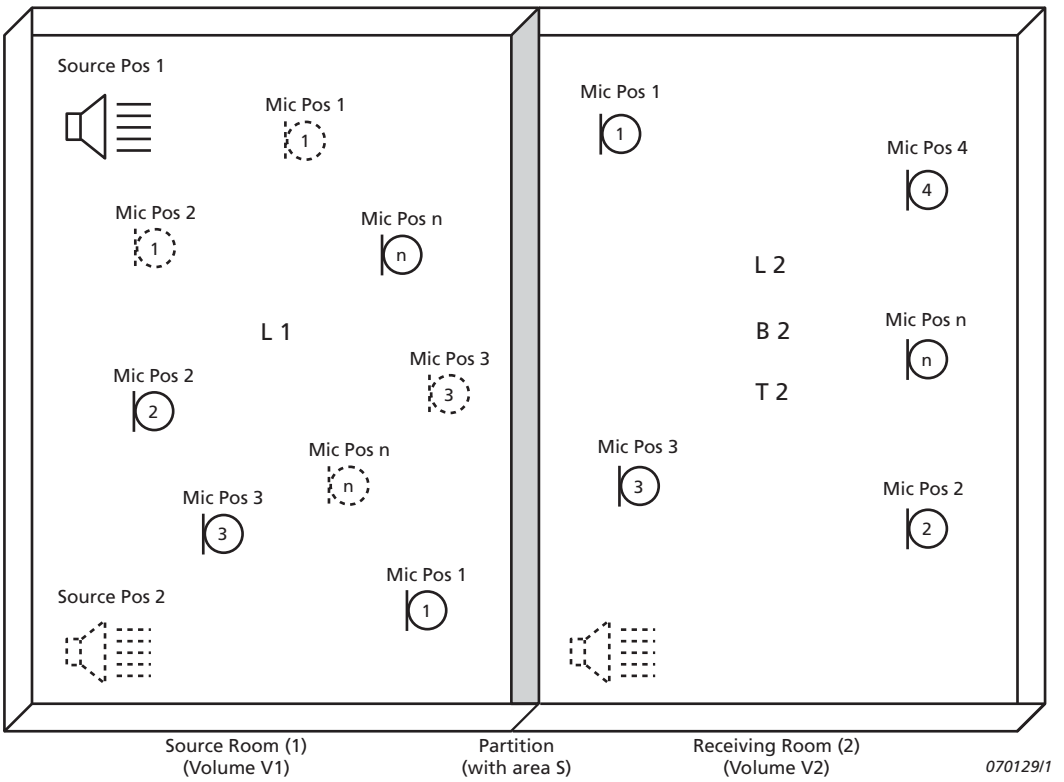
1) **Airborne Sound Insulation** is the sound insulation from one room (the source room) to another room (the receiving room).
2) **Façade Sound Insulation** is airborne sound insulation with the 'source room' being the space outside a building, and the receiving room being inside the building.
3) **Impact Sound Level** is the sound level in the receiving room from a standardised tapping machine in the source room.

These tasks will be described in more detail in section 2.2.

Reverberation time is also used in the calculation of building acoustics. Determining reverberation time has two purposes: determining the absorption coefficient for building materials and checking the reverberation time according to building regulations, for example, in stairwells, classrooms and work spaces.

To aid understanding, an illustration on how to set up airborne sound insulation measurements has been provided. This will help you visualise what we will be talking about in the next sections and will help to introduce you to some of the terms used, see Fig. 2.1.

Fig. 2.1 *Typical setup for airborne sound insulation measurement*



L1 refers to the sound level measurements made in Source Room (1) – these are used in airborne and façade sound insulation calculations.

L2 refers to the sound level measurements made in Receiving Room (2) – these are used in airborne, façade and impact sound insulation calculations.

B2 refers to the background sound level measurements in Receiving Room (2) – these are used for background level corrections in airborne, façade and impact sound insulation calculations.

T2 refers to the reverberation time measurements made in Receiving Room (2) – these are used in airborne, façade and impact sound insulation calculations

Please note: The annotations denote where the measurement was taken. For example, L1 measurements are taken in Source Room (1) hence the L1 annotation, and the L2, B2 and T2 measurements are taken in Receiving Room (2) hence the L2, B2 and T2 annotations.

In practice, when making measurements 'in the field' there are many considerations to be taken into account while making building acoustic measurements. For example, is the room empty or furnished, large or small, regularly or irregularly shaped, all these things affect the reflection of sound within the room and change the sound field in the room.

This can cause variations in sound pressure level within the source room, so measurements are normally made at several points in the room. You might choose, for example, two sound source positions and three microphone positions, see Fig.2.1. The resulting averaged spectrum is used in the sound insulation calculations.

Similarly, a series of measurements are made at different positions in the receiving room to allow for sound pressure variations. The resulting averaged spectrum is used in the impact or sound insulation calculations.

The sound insulation calculations are then made, using combinations of the above values, according to a wide range of international standards, see section 2.2.1 and section 4.2.1.

Please note: In some standards, the L1 and L2 levels are not averaged for each room separately, irrespective of sound source. Instead each level measurement is identified as belonging to one particular source. Averaging is made in two steps:

- Averaging L1-L2 for each source
- Averaging L1-L2 contributions

2.1.2 Partitions

Sound insulation refers to a specific 'separating' part of a building (for example, a wall, floor or window). Partition is the common term used in all tasks.

2.1.3 Field versus Laboratory Measurements

Field Measurements

Measurements in the field are performed in situ on partitions of buildings. The results are used to document conformance to building regulations. In field measurements, sound and vibration propagate not just via the partition under investigation, but also via other partitions, structures and leaks. This propagation is called 'flanking' transmission.

Laboratory Measurements

Measurements in the laboratory are made on building elements such as wall panels or windows mounted in special test rooms, designed and tested to prevent 'flanking'. The measurements follow uniform and strict procedures, and the measuring equipment is usually permanently installed. The results are used by manufacturers to document the performance of their products.

2.1.4 Correction for Background Noise

If the background noise level B2 comes within 15 dB of the receiving room level L2, it starts affecting the measured L2 level. Depending on the standard, correction is made to L2 for the influence of the background noise level. The correction varies depending on the level difference L2 - B2. When the background noise level comes too close to the receiving room level, a fixed

correction to L2 is made and the measurement results are marked to indicate that a correction has been made.

2.1.5 Spatial Averaging

The averaging of levels in a room may be done using a moving microphone, for example, mounted on a rotating boom such as Type 3923, or by averaging the levels measured in a number of positions.

The average reverberation time in a room is calculated from the average result for a number of positions either by averaging the reverberation times or by averaging the decay curves and then calculating the reverberation time for the average decay (ensemble averaging).

2.2 Measurement Procedure

2.2.1 Standards

Hand-held Analyzer Type 2250/2270 with BZ-7228 software (or Type 2270 with BZ-7228 and BZ-7229 software) can measure and calculate results according to a wide range of national and international standards, which include:

- ISO (ISO 16283 and ISO 140) – international
- SS – Sweden
- DIN – Germany
- ÖNORM – Austria
- BS – UK
- BREW – England/Wales
- Sia – Switzerland
- UNI – Italy
- NF – France
- NBE – Spain
- CTE – Spain
- NEN – Netherlands
- NEN'06 – Netherlands
- ASTM – USA

Further details of these standards can be found in Appendix B, Table B.1.

For practical reasons, instructions will be given for the ISO standard, which in many cases forms the basis of national standards.

2.2.2 Airborne Sound Insulation

Airborne Sound Insulation is calculated from the L_{Zeq} spectra for the average source room level, L1, average receiving room level, L2, receiving room background noise level, B2 and average reverberation time, T2, see Fig. 2.1.

The sound source should be an omnidirectional loudspeaker, emitting either pink or white noise depending on measurement conditions.

Source Room (L1) Measurements

Place the sound source in the source room to make the L1 sound level measurements, see Fig. 2.1.

Several measurement points should be used for the sound source and the microphone. You should choose two sound source positions and a minimum of five microphone positions.

The source room level, L1, is the resulting average for positions 1 to n. It is used in the sound insulation calculations.

Receiving Room (L2) Measurements

L2 level measurements are made in the receiving room, see Fig. 2.1.

As with L1, make a series of measurements at different positions for each sound source position in the source room, in order to allow for sound pressure variations. The resulting averaged spectrum is used in the calculations.

Typical L1 and L2 Measurement Cycle

The different stages of a typical L1 and L2 measurement cycle are illustrated in Fig. 2.2 and described below:

1) Set the **Escape Time** (tap **Main Menu** > **Setup** > **Generator L1 and L2** > **Escape Time** and enter the time), which allows you to vacate the measurement room, and press **Start**/**Pause** on the analyzer.

2) The noise generator is switched on and the analyzer waits for the chosen **Build-up Time** (tap **Main Menu** > **Setup** > **Generator L1 and L2** > **Build-up Time** and enter the time) to allow for the sound field to reach a steady state.

3) If you are using Type 2250 (or Type 2270 for a single-channel measurement), the analyzer starts to measure from this point.

   However, if you are using Type 2270 (with BZ-7229), it is possible to measure L1 and L2 simultaneously by connecting two microphones to your Type 2270.

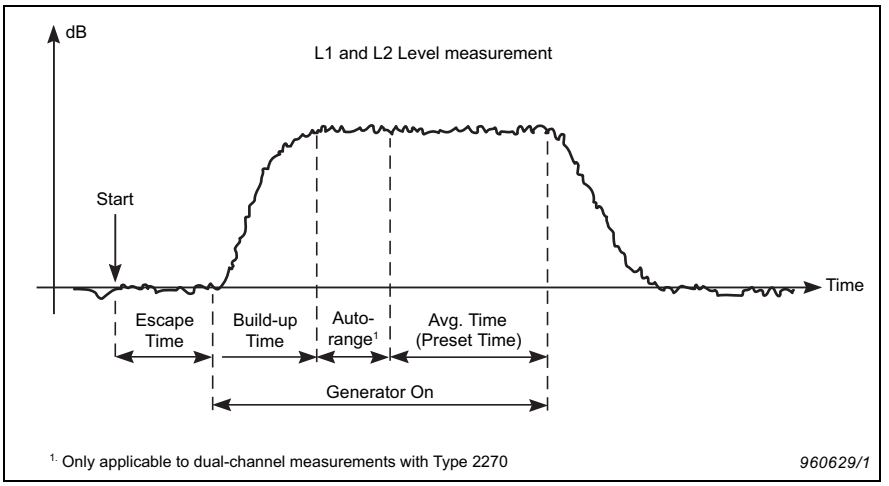
   If this is the case, the analyzer goes into *Autorange* (if this setup option is chosen), where the detected level is used to choose the most convenient range, either *High Range* or *Low Range*.

Please note: See *Hand-held Analyzer Types 2250 and 2270 – User Manual*, Chapter 2, for details about mounting the microphones.

4) The measured spectra are averaged by the analyzer in the chosen averaging time, Avg. Time.

5) The noise generator is switched off.

Fig. 2.2 *Different stages of a typical L1 and L2 measurement cycle*



Receiving Room (B2) Measurements

Background level measurements, B2, are made in the receiving room and can be used for correcting L2 levels automatically, if this setup option is chosen. Ideally, B2 should be measured consecutively with L2 at the same measurement positions.

Typical B2 Measurement Cycle

The different stages of a typical B2 measurement cycle are described below:

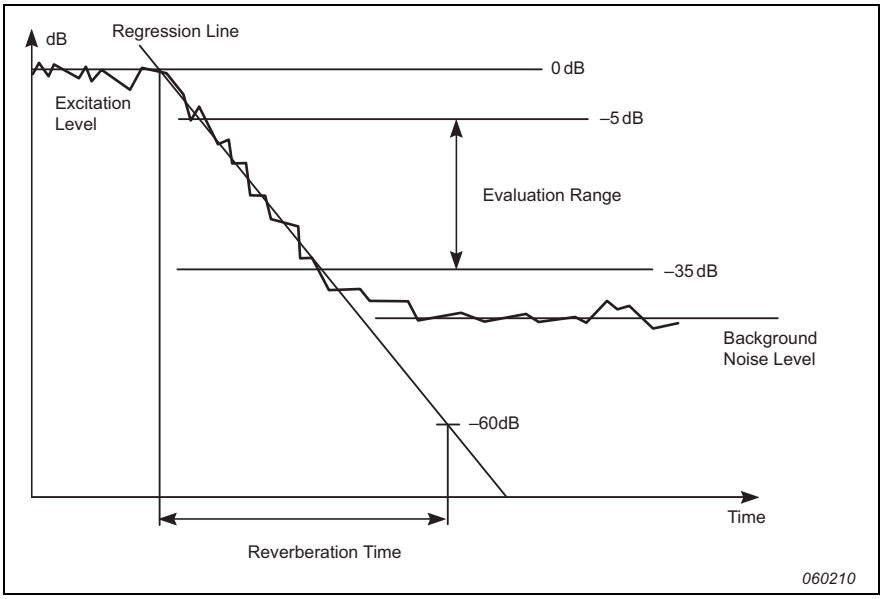
1) Set the **Escape Time** (tap **Main Menu** > **Setup** > **Generator L1 and L2** > **Escape Time** and enter the time), which allows you to vacate the measurement room, and press **Start/Pause** on the analyzer.

2) The measured spectra are averaged by the analyzer in the chosen averaging time, Avg. Time.

Reverberation Time (T2) Measurements

Reverberation time, T2, is the decay time for sound in a room after the excitation stops. It is the time for a 60 dB drop in level, but the decay is usually evaluated over a 20 or 30 dB drop, using the measurements within these ranges to make a regression line, which is then extrapolated to the 60 dB range, see Fig. 2.3.

Fig. 2.3 *Definition of Reverberation Time (T2)*



Reverberation time used in building acoustics is labelled either T20 or T30, depending on which of the two evaluation ranges were used.

All measurements are made in the receiving room. As with L1, L2 and B2 measurements, a series of measurements are made at different positions in the room to allow for spatial variations of reverberation decay.

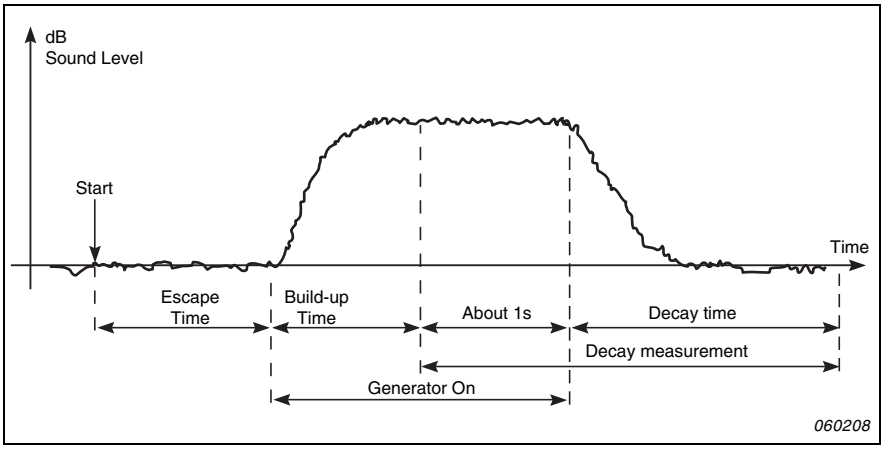
A reverberation time measurement is made using the 'interrupted noise' or 'impulse excitation' methods, as follows:

Interrupted Noise Method

1) Set the **Escape Time** (tap **Main Menu** > **Setup** > **Generator T2** > **Escape Time** and enter the time), which allows you to vacate the measurement room, and press **Start**/**Pause** on the analyzer.

2) The noise generator is switched on and the analyzer waits for the chosen **Build-up Time** (tap **Main Menu** > **Setup** > **Generator T2** > **Build-up Time** and enter the time) to allow for the sound field to reach a steady state.

Fig. 2.4 *Typical reverberation time (T2) measurement cycle for interrupted noise method*



3) The decay measurement starts. The level for the first second, or so, is used to identify the excitation sound level as the 0 dB reference level.

4) The noise generator is switched off and the sound level begins to decay.

5) The decay measurement ends when only the background noise level is measured (automatically detected by the analyzer).

6) Steps 2) to 5) are automatically repeated a chosen number of times and the measured decays are averaged together to reduce the uncertainty of the measurement.

7) The reverberation time spectra T20 and T30 are calculated and displayed on the screen.

Impulsive Excitation Method

1) Set the **Trigger Level** (tap **Main Menu** > **Setup** > **Measurement Control T2** > **Trigger Level** and enter the level)

2) Press the **Start**/**Pause** pushbutton, and the analyzer waits for the level to exceed the trigger level (the traffic light will flash green every second).

3) The impulse excitation (for example, a starting pistol is fired or a balloon is burst) is made.

Caution: The use of hearing protection is highly recommended.

4) The impulse measurement is started 1 s before the level exceeds the trigger level.

5) The impulse measurement stops after the analyzer detects the background noise level again (automatically measured by the analyzer).

6) The analyzer performs backward integration of the impulse measurement (according to the Schroeder method).

7) The reverberation time spectra T20 and T30 are calculated and displayed on the screen.

The measurement is in octaves or 1/3-octaves in parallel over a selectable frequency range. In each frequency band, the decay is sampled 200 times each second.

In theory, the resulting decay will be equivalent to the average of a large number of decays using the interrupted noise method. Therefore, the decay will be smooth using a single shot.

2.2.3 Façade Sound Insulation

Façade sound insulation is airborne sound insulation with the 'source room' being the space outside a building and the receiving room being inside the building, see Fig. 2.5.

The loudspeaker sound source should be positioned at an angle of 45° to the centre of the partition (or wall) and generating pink or white noise.

The outdoor level, L1, is the resulting average for positions 1 to n, placed at the partition, and is used in the sound insulation calculations.

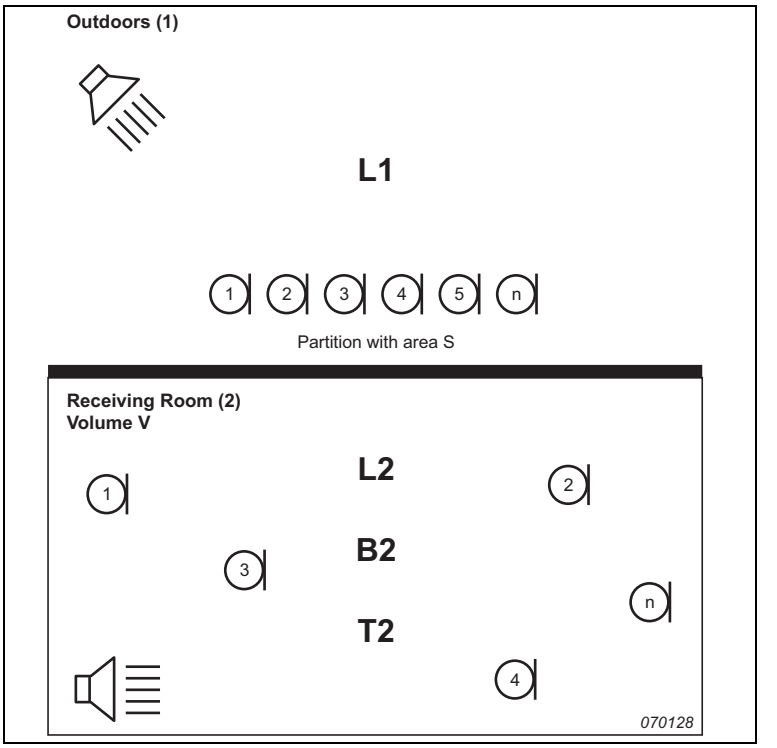
Façade sound insulation is then calculated from the L_{eq} spectrum for the average outdoor level, L1, average receiving room level, L2, average receiving room background noise level, B2 and average reverberation time, T2.

The B2 and T2 measurements are performed in a similar way to those described previously in Section 2.2.2.

Traffic Noise

Owing to the varying character of traffic noise, L1 and L2 need to be measured simultaneously for each set of L1/L2 positions, and the L1-L2 differences are then averaged. For this reason you will need a dual-channel Type 2270 to perform this task.

Fig. 2.5
Typical setup for façade sound insulation measurement



2.2.4 Impact Sound Level

Impact Sound Level is the sound level in the receiving room from a standardised tapping machine in the source room, see Fig. 2.6.

The sound source for L2 is a standardised tapping machine (for example, Brüel & Kjær's Type 3207), which is placed in the source room to simulate footsteps. The sound source used for T2 is interrupted noise or impulsive noise.

Impact Sound Level is then calculated from the L_{Zeq} spectra for average receiving room level, L2, reverberation time, T2 and receiving room background noise level, B2).

Please note: All spectra (average L2, B2 and T2) are measured as the average of several source/microphone positions.

The L2, B2 and T2 measurements are performed in a similar way to those described previously in section 2.2.2.

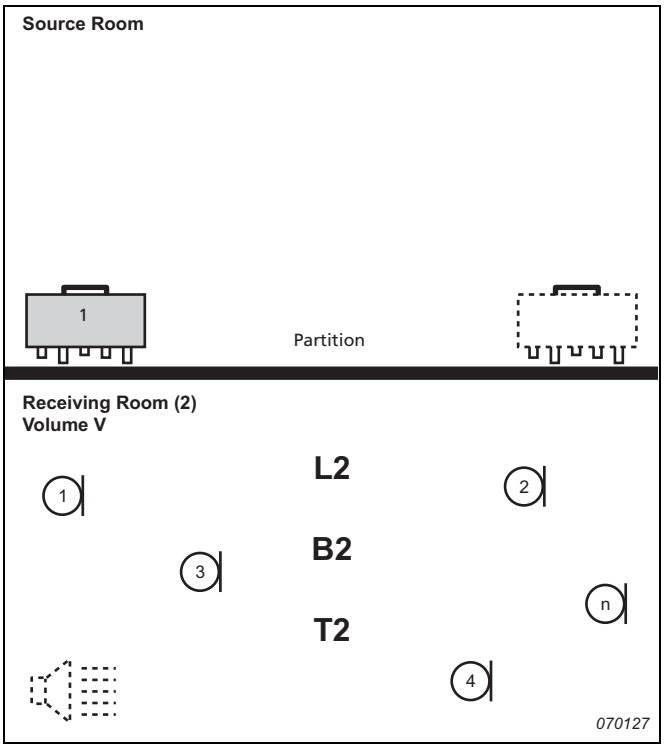


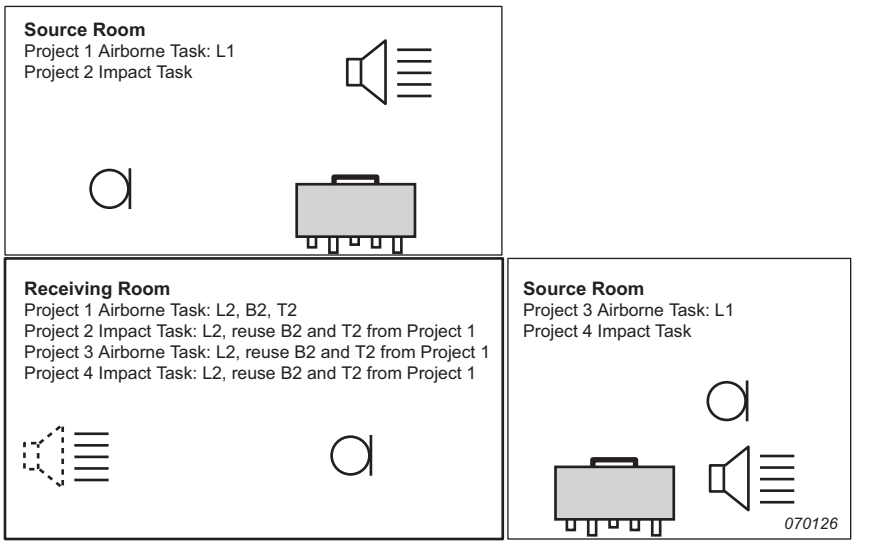
Fig. 2.6
Typical setup for impact sound level measurement

2.2.5 Combined Tasks and Measurements

Often more than one partition in a room is investigated, more than one task performed for the same room or partition, or several physically identical rooms in a building are measured. This means some parameters need be measured only once then reused in the calculations for several partition, tasks or rooms. An example is shown in Fig. 2.7.

The need for good bookkeeping with metadata and annotations is evident. Type 2250/2270 supports metadata, annotations and the reuse of partition data (see Chapter 4 for more information).

Fig. 2.7 *Typical example showing how you can combine tasks and measurements*


Source Room
Project 1 Airborne Task: L1
Project 2 Impact Task
Receiving Room
Project 1 Airborne Task: L2, B2, T2
Project 2 Impact Task: L2, reuse B2 and T2 from Project 1
Project 3 Airborne Task: L2, reuse B2 and T2 from Project 1
Project 4 Impact Task: L2, reuse B2 and T2 from Project 1
Source Room
Project 3 Airborne Task: L1
Project 4 Impact Task
070126

2.2.6 Serial Measurements

When using the internal noise generator (L1, L2 and T2), you can enhance the signal to noise ratio by limiting the frequency range of the noise to cover just a single frequency band, while keeping the output power constant.

You first make a parallel measurement, then, if the signal to noise ration is too low in a few bands (typically at low frequencies) you select these bands for serial measurements. You can then redo the measurements including only these bands and merge the results with the parallel measurement.

This method can also be used to redo L1 and L2 measurements at frequencies where the L1 band levels at adjacent bands differ by more than 6 dB (for ISO 140) or 8 dB (for ISO 16283).

2.2.7 2-channel Measurements

Type 2270 can measure two positions simultaneously, thus reducing the measurement time.

You place two microphones at the positions you want to measure and both positions are measured simultaneously. Cabling is easy, because Type 2270 and the two microphones are placed in the same room.

2-channel measurements are possible for all the functions L1, L2, B2 and T2.

Chapter 3

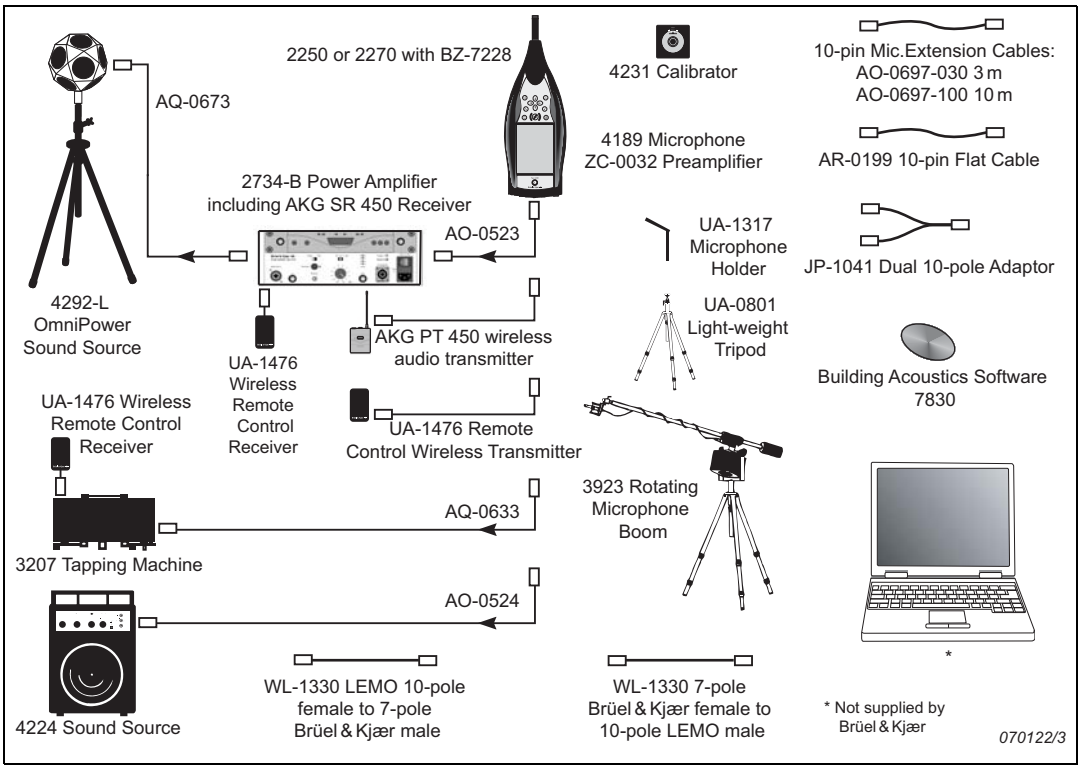
System Overview

This chapter provides an overview of the equipment and accessories used to perform building acoustics measurements using:

- Type 2250 or Type 2270 with Building Acoustics Software BZ-7228 (single channel)
- Type 2270 Building Acoustics Software BZ-7228 and 2-channel Option BZ-7229

Please refer to the system overview diagram in Fig. 3.1.

Fig. 3.1 *System overview diagram*



For further details, see “Ordering Information” on page 73.

Chapter 4

Building Acoustics Software

Building Acoustics Software BZ-7228 enables you to measure building acoustics using your analyzer (2-channel Option BZ7229 is required for Type 2270).

Check the About screen to see whether you have a license to run this module. (To access the About screen, tap the **Help** icon ? then tap **About**.)

4.1 What is a Building Acoustics Project?

When using Building Acoustics Software BZ-7228, it will be useful to know what a building acoustics project consists of, before you start to measure.

A Building Acoustics project contains data for one Partition and one Task: setup parameters, a number of L_{eq} sound level spectra, background level spectra and reverberation time spectra. The data are categorised by means of type and location (for example, room 1 – source room, room 2 – receiving room, etc).

In a project there are up to four categories of data:

- L1: source room sound level spectrum
- L2: receiving room sound level spectrum
- B2: receiving room background noise sound level spectrum
- T2: receiving room reverberation time spectrum

The four categories of data are referred to as Functions, so to measure L1, for example, set **Function** to *L1* (or if L1 and L2 data are measured simultaneously (2-channel measurements, Type 2270 only), set **Function** to *L1&L2*).

4.2 Navigating Building Acoustics Software

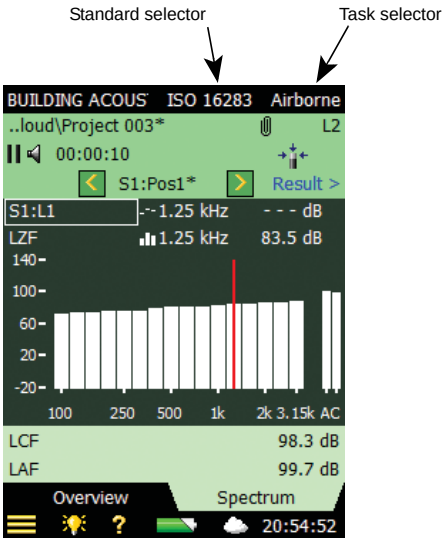
Measurement is controlled in the same way you would control a normal Sound Level Meter measurement, using **Start/Pause**, **Continue**, **Back-erase** and **Reset** pushbuttons, see *Hand-held Analyzer Types 2250 and 2270 – User Manual*, Chapter 3 for more details.

This section describes all the standard drop-down menus, the status panel and general navigation features of BZ-7228 software.

4.2.1 Standard Selector

A Standard selector is provided in the Project Template bar, see Fig.4.1:

Fig. 4.1
Standard selector



The Standard selector is used to select the supported standard on which the measurements and calculations are based, see "Setting the Relevant Standard and Task" on page 27 and "Building Acoustics Standards" on page 95.

The options are:

- *ISO 16283*
- *ISO 16283LF*
- *SS*
- *DIN*
- *ÖNORM*
- *BS*
- *Sia (2006)*
- *UNI*
- *NF*
- *NBE*
- *CTE*
- *BREW*
- *NEN*
- *NEN'06*
- *ASTM*
- *ISO 140*

When a project contains data, the available 'Standard' options are reduced to those compatible with the data.

4.2.2 Task Selector

Next to the Standard selector in the Project Template bar there is a Task selector (an example of an Airborne task is shown in Fig.4.1), see also "Setting the Relevant Standard and Task" on page 27. The options are as follows:

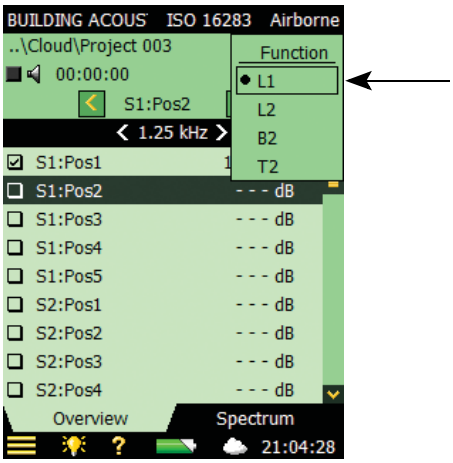
- *Airborne*
- *Impact*
- *Façade*

When a project contains data, then the available Task options are reduced to those compatible with the data.

4.2.3 Function Selector

The Function selector is located in the first line of the Status Field (see Fig.4.2). The options are determined by the selected task and whether L1 and L2 are measured simultaneously (Type 2270 only):

Fig.4.2
Function Selector options



If **Task** is set to *Airborne* or *Façade* and L1 and L2 are measured separately, the options are:

- *L1*
- *L2*
- *B2*
- *T2*

If **Task** is set to *Airborne* or *Façade* and L1 and L2 are measured simultaneously (Type 2270 only), then the options are:

- *L1&L2*
- *B2*
- *T2*

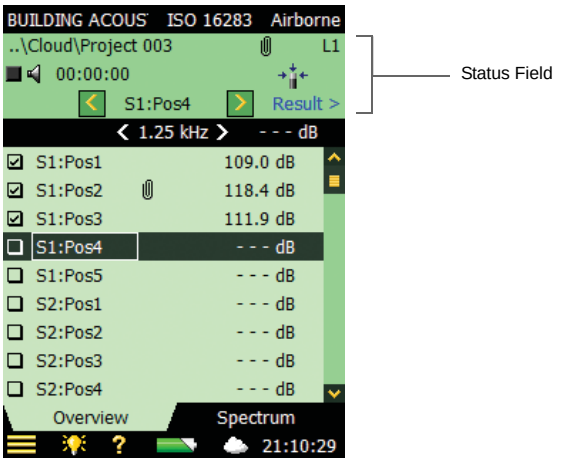
If **Task** is set to *Impact*, the options are:

- *L2*
- *B2*
- *T2*

4.2.4 Status Field

The status field contains various information regarding the current measurement:, see Fig.4.3:

Fig.4.3
Status Field



Line 1:

- Project name and data path (tapping on data path opens the Explorer – see section 4.11)
- Smiley for the Project (if applicable)
- **PC** – connected to Measurement Partner Suite BZ-5503 via USB or a network connection
- **LAN** – connected to a network through an Ethernet cable
- **Wi-Fi** – connected to a network via Wi-Fi. indicates a lost connection
- **Commentary** – spoken commentary is being recorded, together with an indication of the available recording time
- **Recording** – measurement signal is being recorded
- **Paperclip** – an annotation is attached to the project. Tap the icon to go to the Annotations screen
- The Function Selector

Line 2:

- Measurement Status
- Generator On/Off (**Loudspeaker** icon)
- Elapsed Time of measurement
- Feedback on measurement keys
- *Uncal.* – status on calibration
- Overload/Underrange indication
- Transducer icons – one per channel (linked to **Setup**)

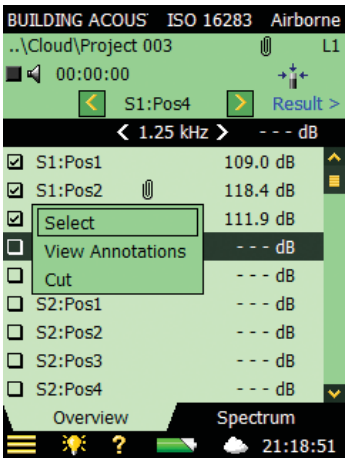
Line 3:

- Position Selector (drop-down menu)
- Icons for stepping backwards or forwards in positions (or)
- Smiley for the position
- Link to results (**),** see section 4.8.

4.2.5 Overview (L1, L2, L1&L2, B2 and T2)

The **Overview** tab shows the measurement positions in a table – one position per row, see Fig.4.4.

Fig.4.4
Overview options



Tap on a position in the table (i.e., *Pos1*) for the following options:

- *Select* (selects the active position, which is highlighted by black bar)
- *View Annotations* (displays the list of annotations for the measurement)
- *Cut* (cuts the measurement for pasting at another position).
- *Paste* (pastes the cut measurement)

Please note: *Cut* and *Paste* are only available in Planned measurements (section 4.4.1) where data already exists.

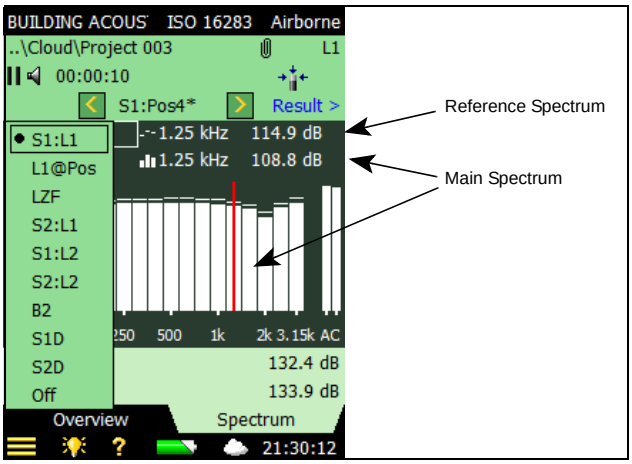
When viewing the *T2* function, tap the top line in the overview for the following options:

- *T20*
- *T30*

4.2.6 Spectrum Tab (L1, L2, L1&L2 and B2)

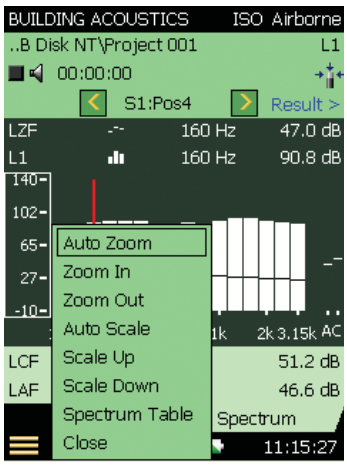
The **Spectrum** tab shows the sound pressure level spectrum for a single measurement position, but you can switch between the main spectrum view and a reference spectrum. The spectra options are shown in Fig.4.5.

Fig.4.5
The spectrum drop-down menu



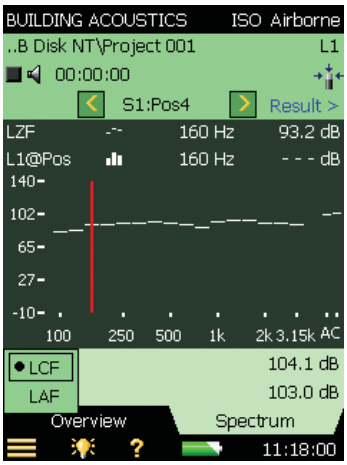
The Y-axis can be changed to suit your measurements, see the options in Fig.4.6.

Fig.4.6
The Y-axis drop-down menu



In the area below the spectrum, two parameters can be shown – both can be selected from drop-down menus, see Fig.4.7.

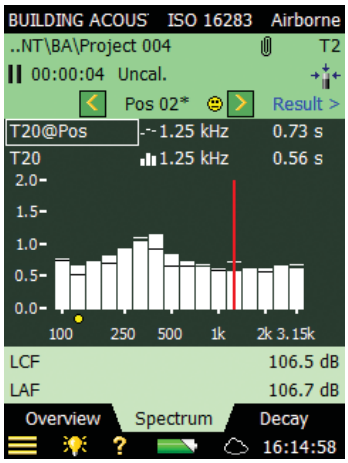
Fig.4.7
The parameter drop-down menu



4.2.7 Spectrum Tab (T2)

The **Spectrum** tab for T2 measurements shows the reverberation time spectrum from a position (i.e., *T20@Pos* or *T30@Pos*, see Fig.4.8), the average reverberation time (i.e., *T20* or *T30*), or both. The sound level is displayed during measurements. For more information, see section 4.5.4.

Fig.4.8
The Spectrum tab



4.2.8 Decay Tab (T2)

The **Decay** tab for T2 measurements shows the reverberation time decay from a position, the average of positions (if **Setup** > **Calculations** > **Ensemble Averaging** is set to *Yes*), or both. For more information refer to section 4.5.5.

4.3 Things To Remember

Display

- Smileys in the spectrum refer to the combined smileys of both selected spectra
- A useful selection of displayed parameters is:

  L1 *L2* *B2* *T2*
  L1@Pos *L2@Pos* *B2@Pos* *T2@Pos*

  You can then check the spectrum for the latest position, as well as the average spectrum, for any function. (For T2 measurements, set **Setup** >**Measurement Control T2** > **Automatic Save** to *Off*).

Reverberation Time

- Reverberation Time: Curvature C% is displayed when *Show Regression Line* is selected from the Y-axis drop-down on the **Decay** tab
- When **Setup** > **Calculations** > **Ensemble Averaging** is set to *Yes*, manual entry must be made in the average T2 spectrum in order to take effect. When **Ensemble Averaging** set to *No*, manual entry can be made in any spectrum
- Decay for the average T2 measurement is shown only with **Ensemble Averaging** set to *Yes*

Measurement Control

- After a Planned measurement, the next position can be automatically or manually selected
- After an Unplanned measurement, the next position will be selected when starting the next measurement

Type 2270 2-channel Setup

- Assign different transducers to the two channels to ensure correct operation. This also applies to Direct inputs
- Microphone icons: the left icon is Ch.1, right is Ch.2
- Measuring L1 and L2 simultaneously:
  - Setting **Setup** > **Input** > **Range Setting** to *High Range* for L1 and *Low Range* for L2 works for most measurements
  - In case of Underrange indication during the averaging time (High Range only), change to *Low Range*. (Or use *Autorange*, which takes a few extra seconds)
  - L1 is Ch.1 and L2 is Ch.2. You may want to reassign B2 and T2 to Ch.2. If you change **Setup** > **Input** > **Measure L1 and L2** to *Separately*, ensure that the channel assignments are as desired
  - 2-channel L1&L2 Overview: *L1* or *L2* shown, click on *L1* to see *L2*, and vice versa

- Measuring two positions (channels) per function:
  - Select *Ch.1* and *Ch.2* as Input for the functions *L1*, *L2*, *B2* and/or *T2*
  - Setting **Setup** > **Input** > **Range Setting** to *High Range* for L1 and T2, and *Low Range* for L2 and B2, works for most measurements
  - In case of an Underrange indication during the averaging time (High Range only), change to *Low Range*. In case of Overload indication during the averaging time (typically Low Range), change to High Range. (Or use *Autorange*, which takes a few extra seconds)
  - Two consecutive positions will be updated each time you save data, data from Ch.1 at the position you have selected, and data from Ch.2 at the subsequent position

Data

- *Cut* and *Paste* in Overview: for Planned measurements only
- *Reuse*: from project in Explorer into the current project
- The date of the projects in Explorer is the date when the project was last saved (e.g., after being opened and reviewed)

4.4 Level Measurements (L1, L2 and B2)

4.4.1 Planned versus Unplanned Measurements

This section contains descriptions on how to set up your analyzer and how to control your level measurements. It also gives examples of how to perform Planned as well as Unplanned measurements.

The Planned measurement setup is required for the BREW and NEN/NEN'06 standards and optional for the other standards. It guides you through each stage of the measurement process in a logical sequence, which means that you can see where you are in the process at any given time. This helps to avoid confusion and can be reassuring when you are dealing with multiple microphone and sound source positions.

ISO 16283 requires L1 and L2 to be planned; however, B2 can either be planned or unplanned.

The Unplanned measurement setup is the one you should use if you are not working to a particular standard, or you do not have to keep track of several sound source positions. Or perhaps you have some previous building acoustics measurement experience and like the flexibility to follow your own procedures.

4.4.2 Trial Measurement

To familiarize yourself with the measurement procedure and to see how easy it is to measure building acoustics, you might like to try an unplanned 'trial measurement' using the default setup and settings in the BUILDING ACOUSTICS Project Template. This template contains the setup and parameters that Brüel & Kjær considers necessary to perform a basic, unplanned building

acoustics measurement, starting with the L1 measurements. (For example, the ISO 140 standard and Airborne task are selected, the microphone is selected, L1 is selected, etc.). All you have to decide is where to position your sound source and your microphone(s) in the source room.

You should not have to change the default settings for your first trial measurements, but later when you have gained more measurement experience, you can change them according to your requirements.

Please note: The default setup and settings are only available immediately after the programme has been installed on your analyzer, these settings are overwritten every time a user saves the BUILDING ACOUSTICS Project Template. So please be aware that the may have been edited by a previous user and check the settings if you are not sure!

Simply select the BUILDING ACOUSTICS Project Template (if not already displayed tap on the black bar at the top of the screen and select BUILDING ACOUSTICS from the drop-down menu that appears) then press **Start**/**Pause** pushbutton to perform the first measurement, and view the result. Finally, press the **Save** pushbutton to save your level measurement at the first position.

Please note: For more detailed information on saving setups and templates and organising your measurements, please refer to the following sections in the *Hand-held Analyzer Types 2250 and 2270 – User Manual*:

- Section 3.4 – Save your Measurement
- Section 6.1 – Organising Measurements
- Section 4.4.8 – How to Manage Templates
- Section 4.4.7 – How to Personalise your Setup

4.4.3 About this Section

If you are not familiar with building acoustic measurements, you should read through the sections on setting up and controlling the instrument (section 4.4.4 and section 4.4.5 that follow) and then work through the planned procedure (section 4.4.6). These sections (together with the analyzer itself) will guide you through the level measurement procedures.

However, if you are already familiar with building acoustic measurements and have a rough idea of the procedure, you can skip the planned procedure and go straight to the unplanned procedure (see section 4.4.7), and read as much of the preceding sections as you need to.

Please note: You can perform single- or 2-channel building acoustic measurements with Type 2270, and single-channel measurements with Type 2250.

Please refer to the following section for single-channel measurements, otherwise see "2-channel Measurements (Type 2270 Only)" on page 53.

4.4.4 Setting up the Instrument (for Single-channel Measurements)

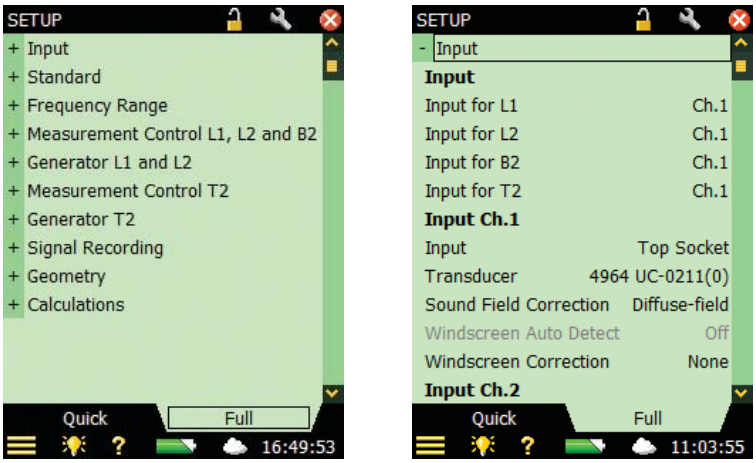
1) Select the BUILDING ACOUSTICS Project Template. The Project Template is displayed at the top of the screen.

2) Tap **Main Menu** > **Setup**, then select the **Full** tab.

Input Selections

For single-channel measurements, set the **Input** parameters to those shown in Fig.4.9.

Fig.4.9
Single-channel Input setup for measuring building acoustics

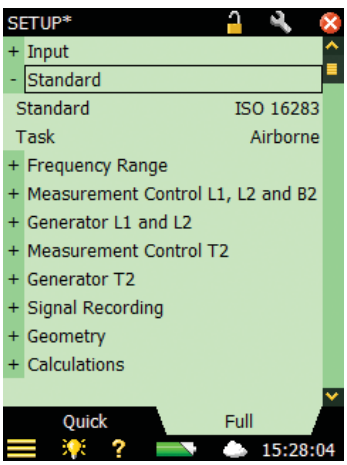


Setting the Relevant Standard and Task

The **Standard** parameter allows you to set the relevant standard for your building acoustic measurement; various options are available (see Appendix A for details).

3) Set the **Standard** parameter, in the example in Fig.4.10, *ISO 16283* has been selected:

Fig.4.10
Setting the Standard and Task for building acoustics measurements



4) Set the **Task** parameter to *Airborne*, *Impact* or *Façade*, whichever is appropriate. (*Airborne* has been selected in Fig.4.10)

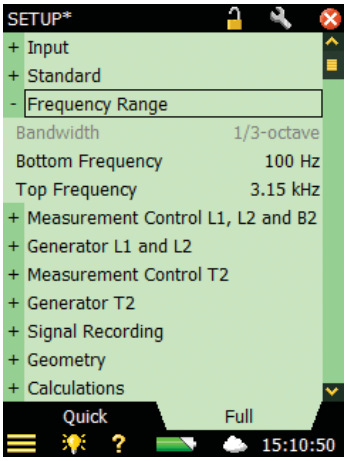
   The task can also be changed by tapping on the task name in the black bar at the top of the measurement screen, and selecting the required task from the drop-down list that appears.

Setting the Bandwidth and Frequency Range

5) Set the **Bandwidth** and **Bottom** and **Top Frequency** of the measurement as required, see the example in Fig.4.11. These parameters are set automatically by the selected standard; however, you can select a wider frequency range than required by the standard.

Please note: While some standards also allow 1/1-octave or 1/3-octave measurements, ISO 16283 locks the **Bandwidth** parameter to *1/3-octave*.

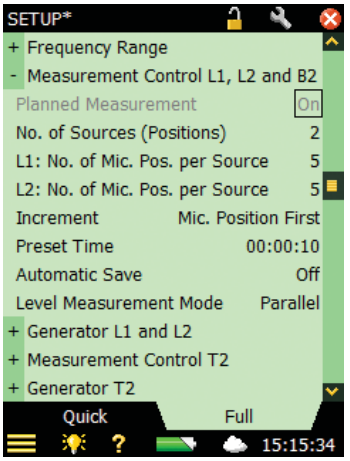
Fig.4.11
Setting the Bandwidth and Bottom and Top frequencies



Measurement Control Setup – L1, L2 and B2

6) Set the measurement control parameters as required, see Fig.4.12:

Fig.4.12
Measurement control setup



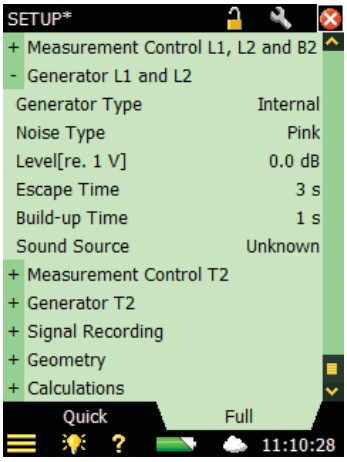
Please note: ISO 16283 locks the **Planned Measurement** parameter to *on* for the L1, L2 and B2 positions.

- **Planned Measurement** – set to *On* if you want to perform the measurement in a planned sequence (and define the number of source positions and microphone positions per source), or set to *Off* if you want to perform the measurements manually from Pos. 1 onwards*
- **No. of Sources (Positions)** – set to the number of sound source positions you are using (only available if the **Planned Measurement** parameter is set to *On*)
- **L1/L2:No of Micr. Pos. per Source** – set to the required number of microphone positions you are using with each source (only available if the **Planned Measurement** parameter is set to *On*)
- **Increment** – this parameter allows you to define the order in which you want to do your measurements: *Source First*, *Mic. Position First* or *Manual*
- **Preset Time** – sets the averaging time (in hours, minutes and seconds), see also Fig.2.2
- **Automatic Save** – set to *Off* if you want to inspect the measurement before manually saving it, or set to *On* if you want to save the measurement automatically
- **Level Measurement Mode** – set to *Parallel* for measuring all bands in a spectrum simultaneously, set to *Serial* for measuring selected bands only (to be saved and merged with a previously measured Parallel spectrum), or set to *Combined* for measuring Parallel and then Serial in an automated sequence. When doing the Serial measurement the bandwidth of the generator will match the selected band, thus increasing the output power for the band and increasing the signal to noise ratio for the band

Generator Setup for L1 and L2

7) **Generator Type**
   - Set to *External* if you want to control an external generator (see Table A.8)
   - Set to *Internal* to use the internal generator, see Fig.4.13.

Fig.4.13
Generator setup for L1 and L2



* Some standards require a planned measurement and for those standards, *Planned Measurement* is automatically selected.

8) **Noise Type** – choose the type of noise for the internal generator, *Pink* noise is typically used.

9) **Level [re. 1 V]** – Adjust the level of the internal generator output to match the input of the power amplifier used.

Hint: You can manually turn the generator on and off by tapping on the loudspeaker icon in the status field.

10) **Escape Time** – set this to allow you to leave the room before the generator is turned on during the measurement.

11) **Build-up Time** – set this to allow the excitation noise to reach a steady state before the measurement starts. One second is adequate in ordinary rooms but should be increased for larger halls.

12) **Sound Source** – select a type matching your sound source. Select *Unknown* if you are using a non-Brüel & Kjær sound source or do not want to make a correction to the frequency response.

    For Brüel & Kjær sound sources, you may linearize the power frequency response in two steps by setting **Sound Source** *Optimum* or *Flat*, which is at the expense of a decrease (by two steps) of the total power.

Setup for Signal Recording

13) **Signal Recording** – set **Recording Control** to *Automatic* if you want to record the microphone signal during the measurement. The recordings can be played back afterwards, so you can investigate why the measurements differed from each other and what the cause was (for example, background noise).

14) **Recording Quality** – this parameter determines the quality of the recording by adjusting the sampling rate. The amount of space required for the recording on the memory card will depend on the selected quality – see Table A.7 on page 87.

15) **Resolution** – set this parameter to fit the signal – see Table A.7 on page 87.

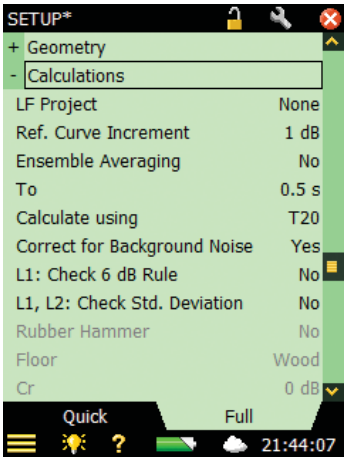
    Recordings will contain the microphone signal from when you press the **Start/Pause** pushbutton until the measurement stops. The recording will be attached to the measurement as an annotation.

Please note: Signal Recording requires a license for the Signal Recording Option BZ-7226, and you may also need a memory card for storing the data.

Setup Calculations

Calculations parameters (Fig.4.14) can be set as required, they are as follows:

Fig. 4.14
Setup for Calculations



16) **LF Project** – Enter the project name (for example, Project 007LF) of the project containing the low-frequency measurement data (see section 4.6 for more information), if required.

17) **Ref. Curve Increment** – set to 1 dB to shift the reference curve in steps of 1 dB when calculating the result parameters. This is the recommended way of operation for reporting correct result parameters as required by the standard.

    Set to 0.1 dB to shift the reference curve in steps of 0.1 dB when calculating the result parameters. This is the recommended way of estimating the uncertainty of the results. Results are displayed with 0.1 dB resolution.

Please note: The parameter has no effect for NEN and NEN'06 standards.

See section 4.8.2.

18) **Ensemble Averaging** – set to *Yes* to average decays from all positions. Average parameters (such as T20) are then calculated based on the ensemble averaged decay, so you can display the average decay. If set to *No,* the 'Avg' parameters are just averages of reverberation times and no average decay is available.

19) **T0** – the reference reverberation time – typically 0.5 s, but it may vary with standards

20) **Calculate Using** – use this parameter to specify which of the measured reverberation time values to use in the calculations. If T30 is specified and available, then T30 is used, otherwise T20 is used.

21) **Correct for Background Noise** – use this parameter to specify whether L2 should be corrected for the background noise, B2, or not.

22) **L1: Check *N* dB Rule** (*N*=6 if ISO 140 is selected and *N*=8 if ISO 16283 is selected) – select *Yes* if you want to check whether the sound spectrum in the source room has differences in level greater than 6 dB between adjacent 1/3-octave bands, or not. The check is done according to the method specified in ISO 140-4:1998, 6.2. If a difference greater than 6 dB is found, then the bands are marked with a yellow smiley. When the smiley is tapped, the following explanation appears: *L1: >*N *dB difference to adjacent band*.

23) **L1, L2: Check Std. Deviation** – select Yes if you want to check whether the standard deviation of the averaged sound spectra in the source and receiving rooms is too big, or not. The check is done according to the method specified in ISO 140-14:2004, A.5. If the standard deviation in a frequency band is greater than twice the theoretical expected value, then the band is marked with a yellow smiley. When the smiley is tapped, the following explanation appears: "*L1 or L2: High Standard Deviation*".

24) **Rubber Hammer** – select *Yes* if you are measuring to the NEN or NEN'06 standard, otherwise select *No*. (Only available if the *Impact* task is selected).

25) **Floor** – select *Wood* or *Stone*, whichever is applicable. (Only available if the *Impact* task and *Rubber Hammer* parameter are selected and you are measuring to the NEN or NEN'06 standard).

26) **Cr** – set the dB level for Cr here, if you are measuring to the NEN or NEN'06 standard. (Only available if the *Façade* task is selected).

27) **Traffic Type** – select *Road*, *Rail*, *Air* or *Other*, whichever is applicable, when you are measuring to the NEN or NEN2006 standard. (Only available if the *Façade* task is selected).

28) **CL** – set the dB level for CL here, if you are measuring to the NEN'06 standard. (Only available if the *Façade* task is selected).

29) **OILR Correction** – set the dB level for OILR correction here, if you are measuring to the ASTM standard. (Only available if the *Façade* task is selected)

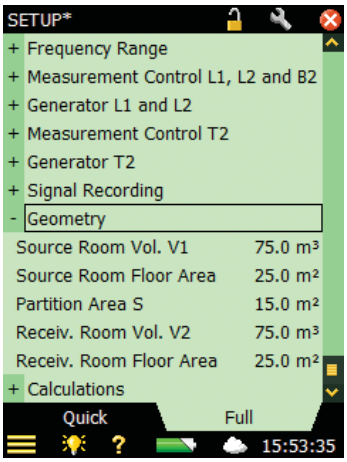
30) **OITL Correction** – set the dB level for OITL correction here, if you are measuring to the ASTM standard. (Only available if the *Façade* task is selected)

31) To exit the Setup screen, tap .

Geometry Tab

Geometry parameters (Fig.4.15) can be set as required, they are as follows:

Fig.4.15
Setup for Geometry



32) **Source Room Vol. V1** – the value you insert here, which is optional, is needed for reports in some standards and is a determinant for whether you need to do special low frequency measurements following the ISO 16283 standard, see section 4.6.

33) **Source Room Floor Area** – the value you insert here, which is optional, is needed for reports in some standards.

34) **Partition Area S** – the value you insert here is used in calculation of results.

35) **Receiv. Room Vol. V2** – the value you insert here is used in calculation of results and is a determinant for whether you need to do special low frequency measurements following the ISO 16283 standard, see section 4.6.

36) **Receiv. Room Floor Area** – the value you insert here, which is optional, is needed for reports in some standards.

4.4.5 Controlling the Measurement

Measurement is controlled in the same way you would control a level measurement, using **Start/Pause**, **Continue**, **Back-erase** and **Reset** pushbuttons, see *Hand-held Analyzer Types 2250 and 2270 – User Manual* Chapter 3for more details.

The measurement control procedures for sound pressure level look very similar to those for measuring reverberation time (see also section 4.6). The only difference between the displays is that the time units (s) are replaced by sound level units (dB) and the reverberation time average (for example T20) is replaced by a sound pressure level average (for example, L1). (The reverberation software also has an extra **Decay** tab, which contains a Decay view, see also section 4.6).

In this section, two examples have been used: one to illustrate how to perform a planned measurement task, and the other to illustrate how to perform an unplanned measurement task

Changing Function

You can change the function (L1, L2, B2 or T2) at any time during the measurement sequence; you do not have to follow a certain sequence if it does not suit you. For instance, you might want to do the L2 measurement before L1, or perform the measurements in a completely random order depending on site conditions.

4.4.6 Example of a Planned Measurement Task

The task is to determine the airborne sound insulation between two rooms according to ISO 16283.

1) Connect the cables, amplifier and sound source (please refer to Fig. 3.1).
2) Under the **Standard** parameter, set **Standard** to *ISO 16283*, and **Task** to *Airborne* (both indicated next to the template selector, see example in Fig. 4.16).

Please note: Only those parameters noted below need to be set up for a Planned Measurement task, the remaining parameters should be left at their default settings.

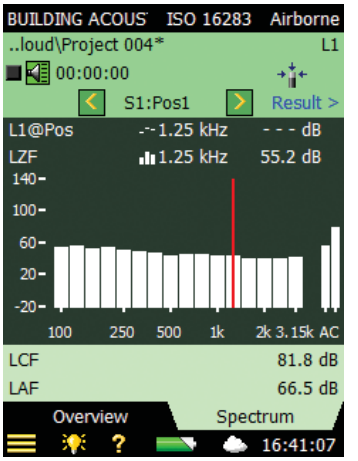


Fig. 4.16 *Typical ISO 16283/Airborne spectrum display*

3) Determine the sound level of the source room will be determined (indicated below the Template Selector, on the second line: *L1*).
4) With an empty Building Acoustics template, set **Setup** > **Measurement Control L1, L2 and B2** parameters:
   - **Planned Measurement** locked to *On*.
   - **Number of Sources (Positions)** to *2*.
   - **L1: No. of Mic Pos. per Source** and **L2: No. of Mic Pos. per Source** to *3*.

5) Check the levels by tapping on the lower parameter of the two parameter selectors shown above the graph, and select the instantaneous level *LZF* (Fig.4.16). You can check the level of the sound source by switching it on and off using the loudspeaker icon .

Hint: LAF and LAC broadband readouts are shown to the right in the spectrum.

Ready for First Measurement

Please note: When measuring according to ISO 16283-1, each source position must be measured for L1 and L2 before moving to the next source position in a default measurement.

6) The third line of the status field shows *S1:Pos1*, this is the position selector and it indicates the current source and microphone position. (The current source and microphone position are also displayed in a list on the **Overview** tab, see Fig.4.17).

7) Select *L1@Pos* instead of *LZF* in the lower parameter and *S1:L1* in the upper parameter. This will allow you to monitor the average level of L1 and the level of the current position throughout the measurement, see Fig.4.17.

8) Press the **Start/Pause** pushbutton to perform the first measurement, *S1:Pos1** will be displayed in the status field. The '*' indicates that the measurement has not been saved.

   After 10 seconds, the measurement data are shown in the black line below the position selector (Fig.4.17, left).

Please note: If a smiley appears during the measurement, it will appear in the black line below the Status Field/Position Selector. Two smileys are shown in Fig.4.17: one is applicable to the 100 Hz band in the black line, and the other smiley above it is for the complete position *S1:Pos1**. Small smileys are set below each frequency band with a potential problem. The smileys are also available at the cursor readouts. Tap on the smiley at the cursor readout for detailed information. (For a description of status indicators and smileys, see "Quality Indicators" on page 60.) The Spectrum is shown in Fig.4.17, right.

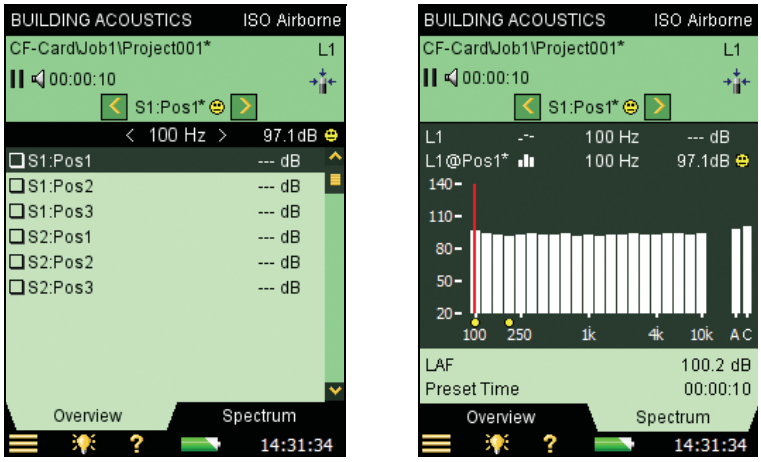


Fig.4.17
Overview and Spectrum tabs after the first measurement

9) Press the **Save** pushbutton. The measurement is saved as *S1:Pos1*. The smiley is updated for the complete project on the upper line. *S1:Pos2* is automatically selected (Fig.4.18).

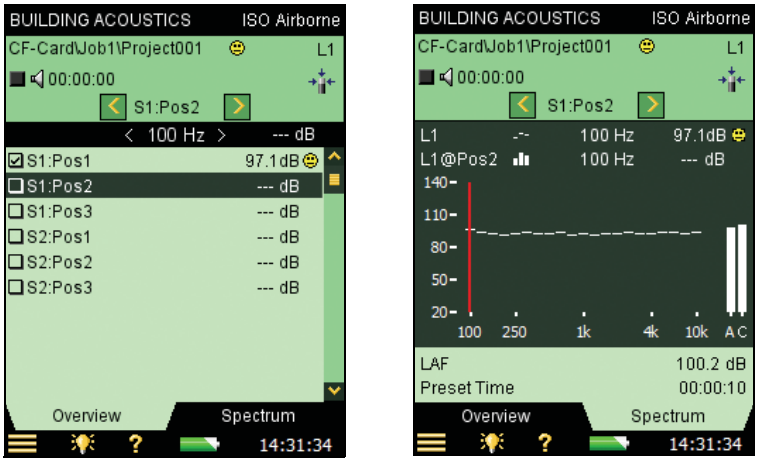


Fig. 4.18
Overview and Spectrum tabs just before the second measurement

10) Press the **Start/Pause** pushbutton to measure in sequence at *Pos2*, *Pos3*, etc.

The selection possibilities for spectrum parameters on the measurement display are listed in Table 4.1

Table 4.1
Spectrum parameters – measurement display

Function	Graph
L1, L2, B2, T2	LZF
L1	L1@Pos
L2	L2@Pos
B2	B2@Pos
T2	T20@Pos
T2	T30@Pos
L1, L2, B2	L1
L1, L2, B2	L2
L1, L2, B2	B2
L1, L2, B2	L1 – L2
L1, L2, B2	L2 – B2
L1, L2, B2, T2	Off
T2	T20
T2	T30

The Overview position selector has the following options available:

- *S1:Pos1*
- *S1:Pos2*
- *S1:Pos3*
- *S2:Pos1**
- *S2:Pos2*
- *S2:Pos3*

(The '*' indicates unsaved data – in this example for *S2:Pos1*.)

11) When the L1 measurements have been done, change the function to L2, B2 or T2 and continue measuring in the same way as described above until all functions have been measured.

Please note: The B2 function has no Planned source/microphone position sequence, you just measure it in a number of positions.

Automatic Increment

The **Increment** parameter (under **Measurement Control L1, L2 and B2** parameters) defines the order in which you want to do your planned measurement: sources first (*Source First*) or microphone positions first (*Mic. Pos. First*). You can also decide to choose each subsequent position manually, see 'Manual Selection of Measurement Position' that follows.

Automatic Save

Set the **Automatic Save** parameter to *On* to automatically save the measurement and increment the position counter to be ready for measuring at the next position.

Manual Selection of Measurement Position

If you select another measurement position, the **Save** pushbutton will save at this position and select the next position as defined by the **Increment** parameter (under **Measurement Control L1, L2 and B2** parameters). This might be a position where some data have already been saved.

An extra pop-up warning will appear if you try to save the data in a position already containing data.

If the **Increment** parameter is set to *Manually* then the position will not automatically change after you save. You have to select a new position before every save operation.

Changing the Number of Sources and Microphone Positions

For planned measurements, you can increase and decrease the number of source positions and the number microphone positions per source in the setup.

Please note: You cannot delete any positions you already have measured.

4.4.7 Example of an Unplanned Measurement

Set the **Planned Measurement** parameter to *Off* if you just want to measure at a number of positions without keeping track of the relation between source and microphone positions, and just want to measure from *Pos1* and forwards.

Please note: This is not available for the standards BREW, NEN, NEN'06, and ISO 16283.

12) Press the **Start/Pause** pushbutton to make a *Pos1* measurement. The result of the measurement is shown in the black line above the table, see Fig.4.19.

Fig. 4.19
Unplanned measurement

Left: Before pressing ***Start/Pause*** *pushbutton on a Pos1 measurement*

Right: The result of the Pos1 measurement before saving

Please note: If a smiley appears during the measurement, it will appear in the black line below the Status Field/Position Selector. Two smileys have been shown for illustration purposes in Fig.4.19: one is applicable to the 100 Hz band in the black line, the other smiley above it is for the complete position *Pos1**. Small smileys are set below each frequency band with a potential problem. The smileys are also available at the cursor readouts. Tap on the smiley at the cursor readout to get detailed information about the warning. (For a description of status indicators and smileys, see "Quality Indicators" on page 60.) The Spectrum is shown in Fig.4.17, right.

13) An empty *Pos1** has been created and selected in the table. Press the **Save** pushbutton and the measurement is saved at *Pos1*. The smiley is updated for the complete project in the upper line.

14) Press the **Start/Pause** pushbutton to make a *Pos2* measurement. The result of the measurement is shown in the black line above the table, see Fig.4.20.

Fig. 4.20
Unplanned measurement

Left: Before pressing ***Start/Pause*** *pushbutton on a Pos2 measurement*

Right: The result of the Pos2 measurement

15) An empty *Pos2** has been created and selected in the table. Press the **Save** pushbutton and the measurement is saved at *Pos2*. The smiley is updated for the complete project in the upper line.

    This will be repeated for every other position in your measurement sequence.

    Unlike the planned measurement, the next position is not selected when pressing the **Save** pushbutton. (With a Planned Measurement, pressing **Start** will always suggest a new position one higher than the number of measured positions.)

Manual Selection of Measurement Position

If you select another measurement position and **Automatic Save** is *Off*, the **Save** pushbutton will save at that position. This will always be at a position that was measured earlier and contains data. A pop-up window will then appear to warn you about overwriting data.

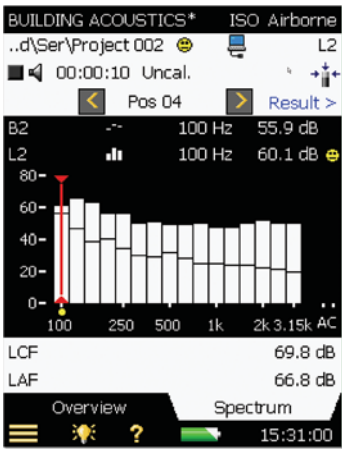
4.4.8 Example of a Serial Measurement

Assuming you have made either a Planned (section 4.4.6) or an Unplanned (section 4.4.7) Measurement Task, then maybe at some frequencies you haven't been able to get a sufficient signal-to-noise ratio. This will show up at frequencies in the L2 function, if the level of the L2 band is too close to the level of the B2 band (background noise), see Fig. 4.21. In this example you can see that the B2 level is at 55.9 dB, and this is too close to the L2 level at 60.1 dB, so a yellow smiley is generated. If you click the smiley, you will be informed that the background noise level is too high.

Then you either have to lower the background noise (which might not be possible) or increase the power of the loudspeaker in the source room.

If your loudspeaker already produces as much noise as possible, then you can limit the frequency range of the noise to cover just a single frequency band, while keeping the output power constant – thus increasing the noise level in the smaller frequency range. For a 1/3-octave band this will increase the noise level at the band by up to 10 dB.

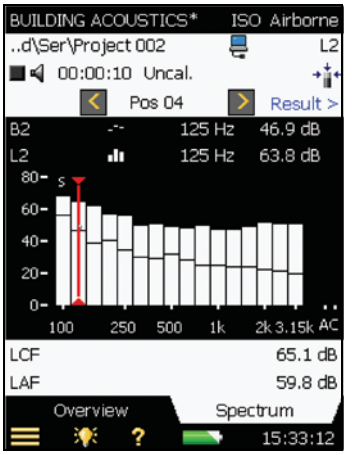
Fig.4.21
Indication that the background noise level is too high



To select the frequency bands to be measured (using noise limited to cover these bands only), tap **Main Menu** > **Setup** > **Measurement Control L1, L2 and B2** > **Level Measurement Mode** and select *Serial*.

On the **Spectrum** tab, select the bands you want to measure using the cursor and tap on the x-axis to select the band for serial measurement, see Fig.4.22.

Fig.4.22
Selecting the bands for serial measurement



Please note: A small 's' appears above the selected frequency bands, see Fig.4.22.

When you have selected the frequency bands you want to re-measure, press the **Start/Pause** pushbutton. The analyzer will then start at the lowest selected frequency band, generate noise at this band, make the measurement and automatically step to the next selected band. This will continue until all selected bands have been measured. Press the **Save** pushbutton to save and merge the bands with the measurement you have already done – be sure to select the right position before saving.

Please note: You need to measure the same bands serially at all the positions you have measured for both L1 and L2. (If you do not measure them serially, a red smiley warns you of the problem. Similarly, a yellow smiley informs you which bands have been measured serially.)

Combine Parallel and Serial Measurements in an Automated Sequence

You can speed up the measurement process if you start investigating whether you need to use serial measurements at certain frequency bands, or not. If you need to measure some bands serially, then you can select tap **Main Menu** > **Setup** > **Measurement Control L1, L2 and B2** > **Level Measurement Mode** and select *Combined.* Then select the bands you want to measure serially like you did in the previous section.

Pressing the **Start/Pause** pushbutton will now make a normal parallel measurement and then do the serial measurements – all in an automated sequence.

Please note: Serial measurements can also be used to redo L1 and L2 measurements at frequencies where the L1 band levels at adjacent bands differ by more than 6 dB for ISO 140 or 8 dB for ISO 16283.

4.5 Reverberation Time Measurements (T2)

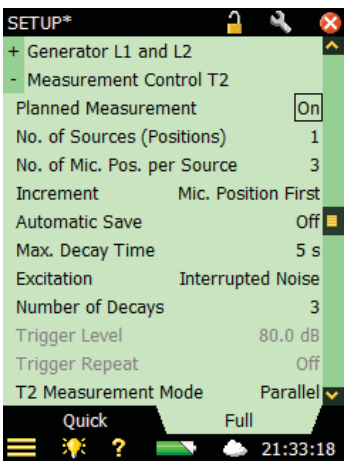
4.5.1 Setting up the Instrument

This section assumes that you followed the procedure in section 4.4, so most default settings are already set up. The following parameters need to set before performing T2 measurements:

1) Set the Function Selector to *T2* and check that the Standard and Task Selectors are still set as required, see Fig.4.1.

2) If you want to define the number of source positions and microphone positions per source, tap **Main Menu** > **Setup** > **Measurement Control T2** > **Planned Measurement** and select *On* (see Fig.4.23); otherwise, the measurements are made manually from *Pos 1* onwards.

Fig.4.23
Measurement control setup for T2



3) Set **No. of Sources (Positions)** parameter to the number of sound source positions you require for your T2 measurement. (Only available if **Planned Measurement** is set to *On*.)

4) Set **No. of Micr. Pos. per Source** parameter to the number of microphone positions per sound source that you require for your T2 measurement. (Only available if **Planned Measurement** is set to *On*.)

5) Set the **Increment** parameter depending on the order in which you want to do your measurements: either *Source First*, *Mic. Positions First*, or manually (*Manual*). (Only available if **Planned Measurement is set** to *On*.)

6) Set **Automatic Save** to *Off* if you want to inspect the reverberation time and decays before manually saving the measurement; otherwise, select *On* to automatically save the decays after each measurement.

7) The analyzer automatically detects the end of the decay; however, under special conditions (for example, when measuring with high background noise) the end of the decay cannot be detected and the measurement will run up to 20 s. To minimise the measurement time and memory requirement for the measurement, you can limit the measurement by setting the **Max Decay Time**. Five seconds is adequate for most ordinary rooms but should be increased for larger halls or reverberation rooms.

8) If you are using a loudspeaker source, set **Excitation** to *Interrupted Noise* and go to step 9). Otherwise, if you want to measure using the impulse method (i.e., using a balloon burst or a starting pistol), set **Excitation** to *Impulsive* and go to step 11). (For a description of these two methods, please refer to the – *Hand-held Analyzer Types 2250 and 2270 – User Manual*, 14).

Interrupted Noise Method

9) Set the number of decays you want to measure per position. The analyzer automatically controls the generator, measurement of the decays and averaging the decays. (Only available if the **Excitation** parameter is set to *Interrupted Noise*).

10) Set **Generator** as required. These parameters are the same as those described in the Level Measurements section. See "Generator Setup for L1 and L2" on page 29. Go to step 13).

11) **T2 Measurement Mode** – set to *Parallel* for measuring all bands in a spectrum simultaneously, set to *Serial* for measuring selected bands only (to be saved and merged with a previously measured Parallel spectrum), or set to *Combined* for measuring Parallel and then Serial in an automated sequence. When doing the Serial measurement the bandwidth of the generator will match the selected band, thus increasing the output level of the band and increasing the signal to noise ratio for the band.

    Serial measurements for T2 are made in a similar way to L1 and L2 measurements – see the example in section 4.4.8.

Impulsive Method

12) Set **Trigger Level** low enough to be sure the impulse will be triggered, but high enough to avoid triggering on the background noise – between 80 and 100 dB is normally adequate. (Only available if the *Excitation* parameter is set to *Impulsive*.)

13) If you have selected **Automatic Save** = *yes*, then **Trigger Repeat** can be set to *yes* to automatically start a new measurement when a measurement has been saved. (Only available if the **Excitation** parameter is set to *Impulsive*.) This allows you to go to another position and make a new impulse without the need for controlling Type 2250/2270 between the measurements. Observe how the Traffic Light indicates the status of the measurement, making it easy for you to change position and generate the impulse synchronised with the measurement procedure. Press the **Start**/**Pause** pushbutton to stop the measurement when the last measurement has been saved.

Generator Setup for T2

The parameters for setting up the generator for Reverberation Time measurements (T2) are identical to those for the generator setup of L1 and L2 (see Fig.4.13 and "Generator Setup for L1 and L2" on page 29).

Signal Recording

The parameters for setting up Signal recording are identical to those described in "Setup for Signal Recording" on page 30).

Controlling the Measurement

Measurement is controlled in the same way you would control a level measurement, using **Start/Pause**, **Continue**, **Back-erase** and **Reset** pushbuttons, see *Hand-held Analyzer Types 2250 and 2270 – User Manual* Chapter 3 for more details.

Planned Measurements

- Press the **Start/Pause** pushbutton when the first measurement position (*S1:Pos1*) is highlighted in the Overview table. When the measurement is finished *S1:Pos1** will be displayed
- Press the **Save** pushbutton to save the measurement at the *S1:Pos1* position. *S1:Pos2* will be selected automatically. Press the **Start/Pause** pushbutton to measure in sequence at Pos2, Pos3, etc.

Unplanned Measurements

- Press the **Start/Pause** pushbutton to make a *Pos1* measurement. An empty *Pos1** has been created and selected in the Overview table
- Press the **Save** pushbutton to save the measurement at *Pos1*
- Press the **Start/Pause** pushbutton to make a *Pos2* measurement and repeat the above procedure for the remaining positions in your measurement sequence

4.5.2 Displaying the Results

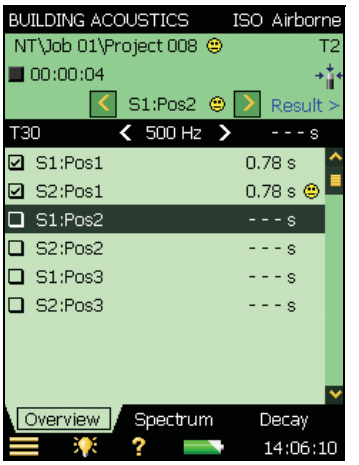
The Reverberation Time measurement screen includes three tabs at the bottom: **Overview**, **Spectrum** and **Decay**. You can view the measurement results in three different ways using the tabs at the bottom of the screen:

- **Overview**: Shows the measurement positions in a table – one position per row. Use this to get an overview of your measurements, to include/exclude positions from the spatial average of all positions in the room, and to manage annotations/signal recordings at the positions
- **Spectrum**: Shows the reverberation spectra graphically, or as a table, for one position, or for the room average. Alternatively, it can show the instantaneous sound pressure level while measuring
- **Decay**: Shows the reverberation decay at a single frequency, for one position, or for the room average (set **Main Menu** > **Setup** > **Calculations** > **Ensemble Average** to *Yes*)

4.5.3 Overview

The **Overview** tab shows the measurement positions in a table – one position per row.

Fig.4.24
***Overview** tab*



The header row contains (from left to right):

- The T2 selector (T20 or T30), which determines which T2 to display in the table rows below. It is also linked to the main Spectrum selector and main Decay selector
- The Frequency selector (which includes decrement and increment buttons), determines the frequency of the readouts in the table rows below. The frequency selector is linked to the Spectrum cursor and the frequency of the selected decay
- Readout of the T2 value for the current measurement, before it is saved to a position

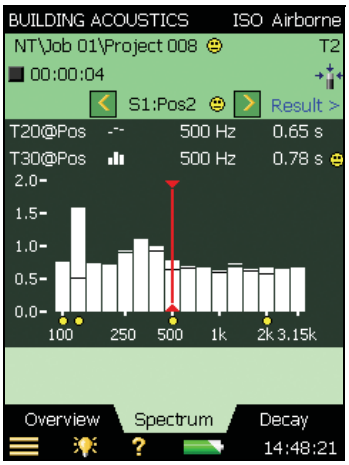
Each row of the table contains (from left to right):

- A checkmark ✓ controlling whether the position is included or excluded from the average. Tap on the checkbox to include (check) or exclude (uncheck) the position. All positions are by default included in the average
- Tap on the position to get a drop-down menu with two options: *Select* and *View Annotations*. Use *Select* to select a position other than the one (automatically) selected if you need to go back and redo a measurement, for example. Use *View Annotations* to view the list of annotations for the position. You can add annotations on the position from this view
- Possible annotations are indicated by 📎. Tap on it to view the list of annotations for the position
- The readout of the T2 parameter at the frequency determined by the T2 selector and Frequency selector in the table header row. There might be a smiley to the right of the readout warning about the quality of the readout. Tap on the smiley to get more detailed information about the warning

4.5.4 Spectrum

The **Spectrum** tab shows the reverberation time spectrum from a position, the average reverberation time, or both. The instantaneous sound level is displayed during measurements.

Fig. 4.25
***Spectrum** tab*



Spectrum Graph

The Spectrum graph is the same as in the L1, L2 and B2 measurements: Two 1/1-octave or 1/3-octave spectra superimposed with cursor readouts. The displayed frequency range is automatically adjusted for the measured frequency range.

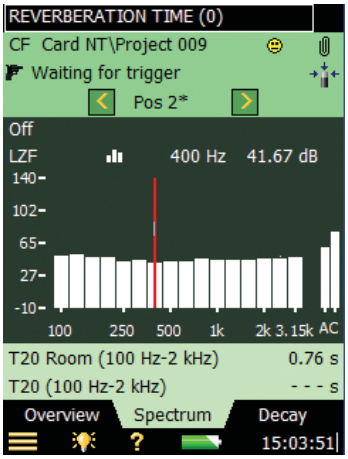
Small smileys are set below each frequency band with a potential problem. The smileys are also available at the cursor readouts. Tap on the smiley at the cursor readout to get detailed information about the warning.

The Spectrum Parameter Selectors above the graph select which spectra to display. You can choose to display: *T20@Pos*, *T30@Pos*, *T20* or *T30*. If you only want one graph, you can set the other to *Off*.

In addition to choosing which parameter to display, you can also select *Display Sound Level*, which will display the Z-weighted spectrum LZF together with the A- and C-weighted broadband levels – see Fig.4.26. When displaying LZF you can tap on the LZF selector and select *Display Reverberation Time* to display the reverberation time spectra.

When starting a measurement the graph will automatically display the sound level spectrum, and when finished it will display the reverberation time spectrum.

Fig.4.26
Spectrum view when measuring



The main spectrum graph on the display (the bar graph) is selected using the parameter selector on the second line of the two shown above the graph (LZF in Fig.4.26). The parameter selector for the main spectrum is linked to the selector on the **Overview** tab and the parameter selector for the main decay on the **Decay** tab.

The other spectrum on the display (the one displayed as small lines above and below the bars in Fig.4.25) is selected using the parameter selector on the first line of the two shown above the graph (*T20@Pos* in Fig.4.25). This spectrum can be used as a reference when comparing it to the main spectrum, and it is linked to the parameter selector for the reference decay curve in the Decay view.

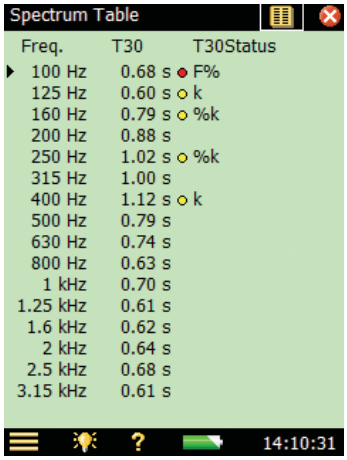
Smileys below the spectra (if there are any) are set if a smiley is present for at least one of the spectra.

The cursor is linked to the frequency selectors on the **Overview** and **Decay** tabs.

Tap on the Y-axis to select:

- **Auto Zoom** to adjust the range of the Y-axis for best fit of the measured spectrum
- **Zoom In/Zoom Out** to adjust the zoom
- **Spectrum Table** to display the spectrum in a table, see an example in Fig.4.27
- **Close** to exit the drop-down

Fig. 4.27
Spectrum table



Auxiliary Parameters

Below the graphics are two lines containing parameters for displaying the LCF and LAF broadband values.

4.5.5 Decay

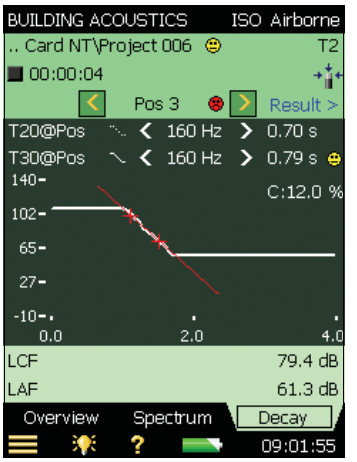
The **Decay** tab shows the reverberation time decay from a position, the average of positions, or both, see Fig.4.28.

Decay Graph

The Decay Graph shows the decay of one frequency band for the selected position, the decay of the same frequency band for the average of positions (requires Ensemble Averaging), or both.

The Decay Parameter Selectors above the graph select which decay to display: *T20@Pos* or *T30@Pos.* Each of these selections show the decay for the measurement at the selected position together with the readout of *T20@Pos* and *T30@Pos* resp. *T20* and *T30* show the decay for the current position. If you only want one graph you can set the other selector to *Off*.

Fig.4.28
Decay view



The main decay on the display (displayed as a continuous line) is selected using the parameter selector in the second line of the two shown above the display (*T30@Pos* in Fig.4.28). The parameter selector for the main decay is linked to the selector on the **Overview** tab and the parameter selector for the main spectrum on the **Spectrum** tab.

The other decay on the display (displayed as a dashed line) is selected using the parameter selector in the first line of the two shown above the display (*T20@Pos* in Fig.4.28). This decay can be used as a reference when comparing it to the main decay, and it is linked to the parameter selector for the reference spectrum on the **Spectrum** tab.

The Frequency band selector (with decrement and increment buttons as well) determines the frequency band of the decay curves. The frequency band selector is linked to the spectrum cursor and the frequency band selector on the **Overview** tab.

Just below the parameter selectors on the right side of the view area, the value of a single status indicator is displayed: C: xx%. This is the curvature indicator, and if it shows above 10%, the status indicator '%' is set, meaning 'Decay is bent'.

For more details on status indicators and smileys, see "Quality Indicators" on page 60.

Tap on the Y-axis to select:

- **Auto Zoom** to adjust the range of the Y-axis for best fit of the measured spectrum
- **Zoom In/Zoom Out** to adjust the zoom
- **Auto Scale** to select the best scaling for viewing the spectra without adjusting the zoom
- **Scale Up/Scale Down** to adjust the full scale value on the Y-axis
- **Show/Hide Regression Line** to show/hide the regression line and the evaluation range for the main decay together with the status indicator C
- **Close** to exit the drop-down menu

4.6 Low-frequency Measurements

ISO 16283 sometimes requires low-frequency measurements in order to correct spectra for rooms where the sound field, may not be approximated to a diffuse sound field, particularly in rooms with a volume smaller than 25 m^3 and where low-frequency content from 50 to 80 Hz is of interest (Table 4.2).

Table 4.2
Functions that require low frequency measurement

Function	Room Size	
	Source Room < 25 m^3	**Receiving Room < 25 m^3**
L1	Yes	No
L2	No	Yes
B2	No	Yes
T2	No	Yes

The measurements consists of:

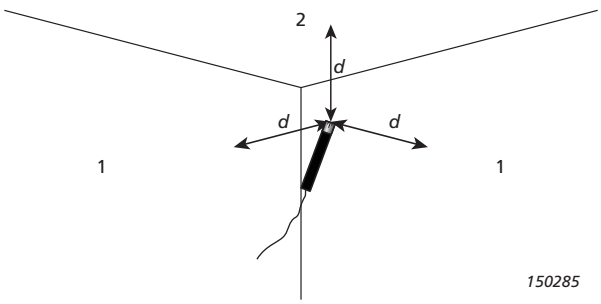
- A set of L1 measurements in a minimum of four corners (where V1 < 25 m^3)

  or
- A set of L2 and B2 measurements in a minimum of four corners and a T2 measurement that is not measured in a corner (where V2 < 25 m^3)

  or
- All the above measurements if both V1 and V2 < 25 m^3

Please note: When measuring T2 (ISO 16283LF) **Bandwidth** is locked to *1/1-octave* and **Bottom Frequency** is locked to *63 Hz*.

Fig. 4.29
An example of corner measurement positioning given in ISO 16283–1, where: 1 represents walls 2 represents the ceiling and distance, d, is between 0.3 and 0.4 m



4.6.1 Using the Low-frequency Measurement Results

Please note: There is no *Results >* link to click. The low-frequency measurement results are only used for corrections for ISO 16283 measurements.

Low-frequency measurement measurements can be performed before or after the ISO 16283 measurement.

To perform the Low-frequency measurement after the ISO 16283 measurement:

1) Set up your analyzer for an ISO 16283 measurement as described in section 4.4 with the following amendments:
   – The **Main Menu** > **Setup** > **Geometry** parameter must have one room volume that is less than 24.5 m^3
   – The **Main Menu** > **Setup** > **Frequency Range** > **Bottom Frequency** must be set to *50 Hz*
2) Perform the ISO 16283 measurement
3) When the last measurement position has been saved, press the **Reset** pushbutton.
   If both conditions in step 1 have been met, pressing will trigger a pop-up dialog.
4) Tap **Yes** to create and open a low-frequency project.
   This will trigger a notice pop-up window advising that the generator settings remain unchanged.
5) Tap **OK**.
6) Set up and perform the low-frequency measurement as normal.

Please note:
- The generator settings for **L1** and **L2** must be identical for the ISO 16283 and ISO 16283LF projects
- The ISO 16283LF project must contain valid data

To perform the low-frequency measurement first:

1) Set up and perform the ISO 16283LF measurement described in section 4.6.2
2) Set up and perform the ISO 16283 measurement as described in section 4.4 and set **Main Menu** > **Setup** > **Calculations** > **LF Project** to the name of the ISO 16283LF project.

Please note:
- The generator settings for **L1** and **L2** must be identical for the ISO 16283 and ISO 16283LF projects
- The ISO 16283LF project must contain valid data

4.6.2 Example of a Low-frequency Measurement Task

The task is to determine the airborne sound insulation between two rooms according to ISO 16283LF.

1) Connect the cables, amplifier and sound source (please refer to Fig. 3.1).
2) Under the **Standard** parameter, set **Standard** to *ISO 16283LF*, and **Task** to *Airborne* (both indicated next to the template selector, see example in Fig. 4.30).

Please note: Only those parameters noted below need to be set up for a Planned Measurement task, the remaining parameters should be left at their default settings.

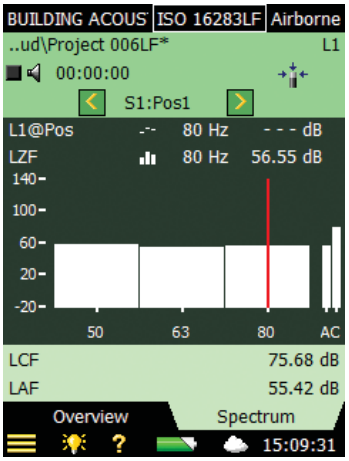


Fig. 4.30
Typical ISO 16283LF Airborne spectrum display

3) The sound level of the source room will be determined (indicated below the Template Selector by the Function Selector *L1*).

4) With an empty Building Acoustics template, under the **Measurement Control L1, L2 and B2** parameters:
   - **Planned Measurement** locked to *On*.
   - Set **Number of Sources (Positions)** to *2*.

     The number of measured B2 and L2 positions are the same because background noise corrections require L1@S1:Pos*N*, L1@S2:Pos*N* and B2@Pos *N* must be measured in the same corner, for each position *N*.
   - Set **L1: No. of Mic Pos. per Source** and **L2: No. of Mic Pos. per Source** to *4*.

5) Check the levels by tapping on the lower parameter of the two parameter selectors shown above the graph, and select the instantaneous level *LZF*, see Fig.4.16. You can check the level of the sound source by switching it on and off using the loudspeaker icon .

Hint: LAF and LAC broadband readouts are shown to the right in the spectrum.

Ready for First Measurement

6) The third line of the status field shows *S1:Pos1*, this is the position selector and it indicates the current source and microphone position. (The current source and microphone position are also displayed in a list on the **Overview** tab, see Fig.4.17).

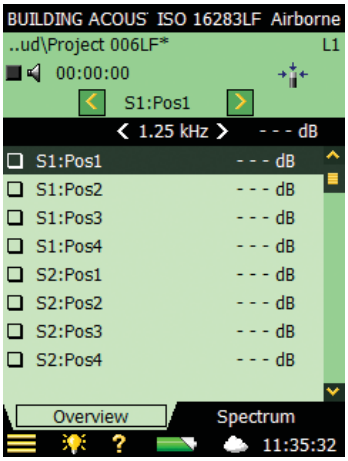
7) Select *L1@Pos* instead of *LZF* in the lower parameter and *S1:L1* in the upper parameter. This will allow you to monitor the average level of L1 and the level of the current position throughout the measurement, see Fig.4.17.

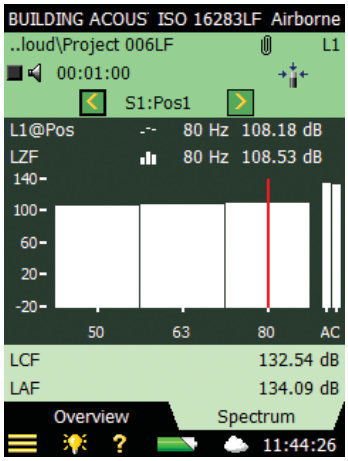
8) Press the **Start/Pause** pushbutton to perform the first measurement, *S1:Pos1** will be displayed in the status field. The '*' indicates that the measurement has not been saved.

   After 15 seconds, the measurement data are shown in the black line below the position selector (Fig.4.31, left).

Please note: If a smiley appears during the measurement, it will appear in the black line below the Status Field/Position Selector. Small smileys are set below each frequency band with a potential problem. The smileys are also available at the cursor readouts. Tap on the smiley at the cursor readout for detailed information. (For a description of status indicators and smileys, see "Quality Indicators" on page 60.)

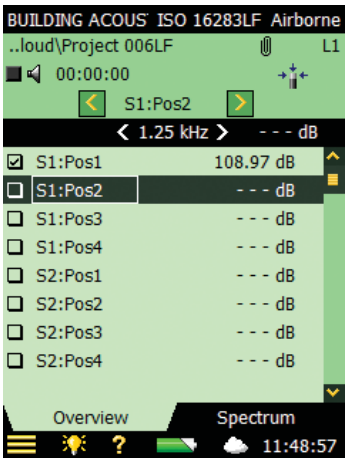
Fig. 4.31 *Overview and Spectrum tabs after the first measurement*

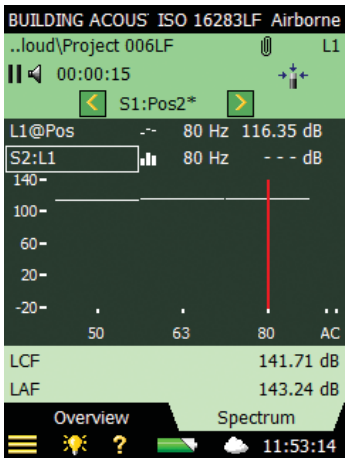




9) Press the **Save** pushbutton. The measurement is saved as *S1:Pos1*. The smiley is updated for the complete project on the upper line. *S1:Pos2* is automatically selected to indicate the next measurement position (Fig.4.18).

Fig. 4.32 *Overview and Spectrum tabs just before the second measurement*





10) Press the **Start/Pause** pushbutton to measure in sequence at *Pos2*, *Pos3*, etc.

11) When the L1 measurements have been done, change the function to L2, B2 or T2 and continue measuring in the same way as described above until all functions have been measured.

Please note: The B2 function has no Planned source/microphone position sequence, you just measure it in a number of positions.

4.7 2-channel Measurements (Type 2270 Only)

4.7.1 Setting up the Instrument (for 2-channel Measurements)

1) Select the 2-Ch. B. ACOUSTICS Project Template. The Project Template is displayed on the black bar at the top of the screen. If it does not display 2-Ch. B. ACOUSTICS, tap the black bar and select 2-Ch. B. ACOUSTICS from the drop-down menu that appears.

Please note: 2-channel measurements require a license for BZ-7229.

2) Tap > **Setup** and select the **Full** tab.

Input Selections

For 2-channel measurements, setting up the analyzer is the same as for single-channel measurements (see section 4.4.4), apart from the following input parameters:

3) Set the **Measure L1 and L2** parameter to either *Simultaneously* or *Separately*, depending on whether you want to measure L1 and L2 at the same time in the source and receiving room or one after the other, see Fig.4.33.

4) Set the **Input for L1**, **Input for L2**, **Input for B2** and **Input for T2** parameters to the required input channel: either *Ch. 1* or *Ch. 2*, depending on which one you are using, or to *Ch. 1 and Ch. 2* if you want to measure two positions simultaneously.

5) Set the **Autorange** to *On* for autoranging Ch.1 and Ch.2, or set it to *Off* for manually setting the range. This is only relevant if the *Measure L1 and L2* parameter has been set to *Simultaneously*, or if the **Input for ...** parameter has been set to *Ch.1 and Ch.2*.

Fig. 4.33
2-channel Input setup for measuring building acoustics using Type 2270

6) For 2-channel measurements, there are also two independent sets of input selections you can set: channel 1 and channel 2. They are set as follows:

   Set the **Range Setting** to *High Range*, or *Low Range* as required. The difference between the two settings is 30 dB. High Range can be used to measure up to the maximum input level. This is only relevant if the **Measure L1 and L2** parameter is set to *Simultaneously*, or if the **Input for ...** parameter has been set to *Ch.1 and Ch.2 Simult.* and **Autorange** is set to *Off*.

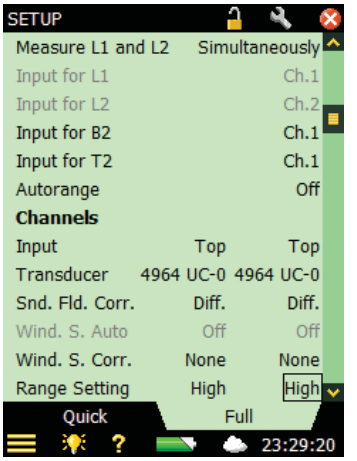


Fig. 4.34 *2-channel input selections for measuring building acoustics using Type 2270*

4.7.2 Controlling the Measurement

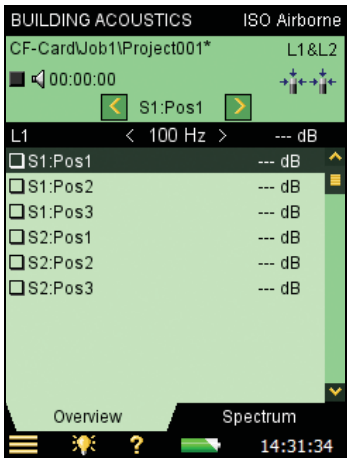
Using two channels in Type 2270 has a couple of advantages over single-channel measurements, these are as follows:

- Measurements of Façade sound insulation, with traffic noise as a sound source, require that the source measurement (outdoors) and receiving room measurements are taken at the same time – this requires 2-channel capability
- Using two channels allows you to measure L1 and L2 simultaneously, which speeds up the measurement process
- Using two channels allows you to measure two positions simultaneously, which speeds up the measurement process

Measure L1 and L2 Simultaneously

7) Set the **Measure L1 and L2** parameter to *Simultaneously* under Input selections. When you then select the *L1&L2* function (see Fig.4.35), the analyzer will measure L1 using Ch. 1 and L2 using Ch. 2.

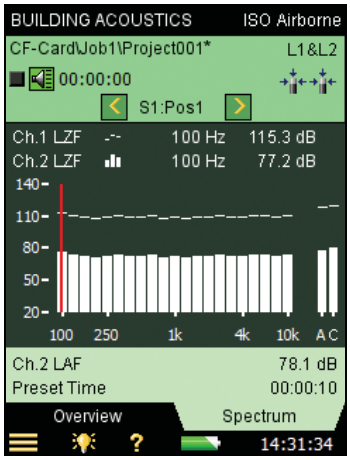
Fig. 4.35
Measuring L1 and L2 simultaneously (Planned measurement)



8) The **Overview** tab still shows either the L1 or the L2 measurements; you select which one to display by the leftmost parameter on the black frequency selection line.

9) Select the **Spectrum** tab to check the levels by selecting the instantaneous levels *Ch.1 LZF* and *Ch.2 LZF*, see Fig.4.36.

Fig. 4.36
Checking the instantaneous levels –during an L1 and L2 measurement



Please note: *Ch.1 LZF* can only be selected in the upper graph and *Ch.2 LZF* can only be selected in the lower graph.

10) You can check sound source level by switching it on and off using .

Please note: LAF and LAC broadband readouts are always shown to the right in the spectrum.

Ready for First Measurement

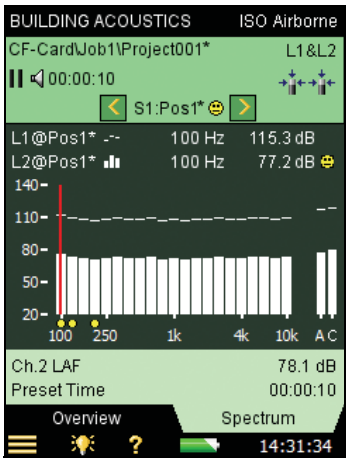
11) The third line of the status field shows *S1:Pos1*. This is the position selector, and it indicates the current source and microphone position. (The current source and microphone position are also displayed in a list on the **Overview** tab, see Fig.4.18).

12) On the **Spectrum** tab, select *L1@Pos* as the upper graph and *L2@Pos* as the lower graph, see example in Fig.4.37.

Please note: If you would like be able to monitor the average level of L1 and L2 throughout the measurement, you can select *L1* as the upper graph and *L2* as the lower graph.

13) Press **Start/Pause** pushbutton to perform the first measurement, this is indicated by *S1:Pos1** being displayed in the status field. The '*' indicates that the measurement has not been saved, see Fig.4.37.

Fig. 4.37
Measurement not yet saved after a simultaneous 2-channel measurement



14) Press the **Save** pushbutton and the measurement is saved as *S1:Pos1*. The smiley is updated for the complete project on the upper line. *S1:Pos2* is automatically selected to indicate the next measurement position, see Fig.4.38. (L1 and L2 are selected again, as they were before pressing the **Start/Pause** pushbutton.)

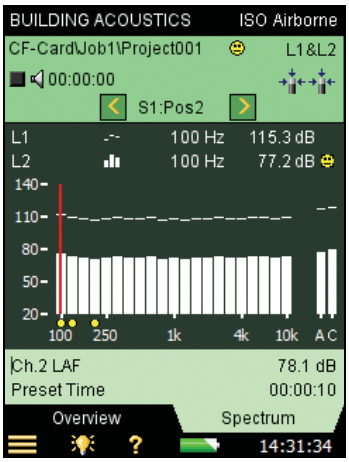


Fig. 4.38
S1:Pos2 automatically selected to indicate next measurement position

15) Press **Start/Pause** pushbutton to measure in sequence at *Pos 2*, *Pos 3*, etc.

The selection possibilities for spectrum parameters (in a Planned measurement) are listed in Table 4.3.

Table 4.3
Spectrum parameters – Result display

Function	Upper Graph	Lower Graph
L1&L2	Ch. 1 LZF	Ch. 2 LZF
B2, T2	LZF	LZF
L1&L2	L1@Pos	L1@Pos
L1&L2	L2@Pos	L2@Pos
B2	B2@Pos	B2@Po
T2	T20@Pos	T20@Pos
T2	T30@Pos	T30@Pos
L1&L2, B2	L1	L1
L1&L2, B2	L2	L2
L1&L2, B2	B2	B2
L1&L2, B2	L1 – L2	L1 – L2
L1&L2, B2	L2 – B2	L2 – B2
L1&L2, B2, T2	Off	Off
T2	T20	T20
T2	T30	T30

The position selector has the following options available for L1, as well as L2:

- *S1:Pos1*
- *S1:Pos1*
- *S1:Pos1*
- *S1:Pos1*
- *S1:Pos1*
- *S1:Pos1*

(The '*' indicates unsaved data – in this example for *S2:Pos1*.)

Measuring Two Positions Simultaneously in the Same Room

To speed up the measurement process, you can measure two positions (channels) simultaneously in the same room.

Set the required **Input for L1**, **L2**, **B2** and **T2** parameters to *Ch.1* and *Ch.2*. Then the measurement process will be the same as for single-channel measurements, except you measure and save data for two positions at a time.

While measuring, the displayed instantaneous spectra will be *Ch.1 LZF* and *Ch.2 LZF*. The measured (but not saved) data will be displayed as two consecutive positions, the first time it will be *S1:Pos 01 ** and *S1:Pos 02 ** (for planned measurements) and *Pos 01 ** and *Pos 02 ** (for unplanned measurements).

When you press the **Save** pushbutton, then two consecutive positions will be updated – data from Ch.1 at the position you have selected, and data from Ch.2 at the subsequent position.

4.8 Displaying Results

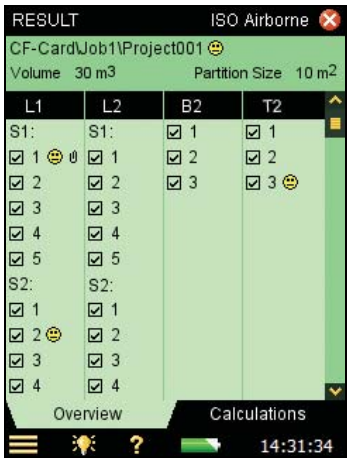
Measurement results are selected using the Result > link in the Status Field (Line 3).

There are two displays: one to get an overview of the measurement results and one for calculation results (including a spectrum).

4.8.1 Overview

The **Overview** tab displays all the results of measurements in the project, see Fig.4.39. It is possible to include or exclude measurements, get details on smileys, and view annotations.

Fig. 4.39
*Viewing results using the **Overview** tab*



The Status Field consists of the following information when viewing results:

Line 1: shows the same information as that described in "Status Field" on page 20

Line 2:

- Receiving Room Volume (linked to *Setup* menu)
- Partition Area (linked to *Setup* menu)

4.8.2 Calculations

The **Calculations** tab allows you to view the calculation results, including a spectrum, see Fig.4.40.

The Status Field consists of the same information as the **Overview** tab, see previous section.

The options for the reference spectrum parameter on the results view are:

- Reference Curve
- Deviations (between the reference curve and the main spectrum)
- Off

The options for the main spectrum parameter on the results view depend on the selected standard and task. For example, if the **Standard** parameter is set to *ISO 16283* and the **Task** parameter is set to *Airborne*, the options are:

- D
- Dn
- D_nT
- R'
- R

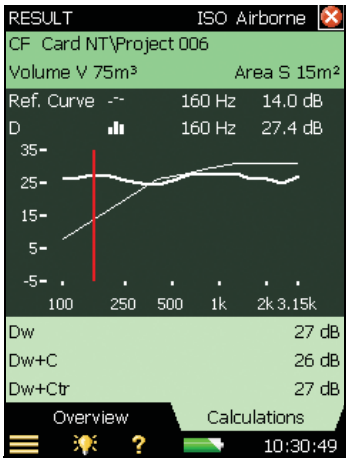


Fig. 4.40
Viewing calculation results using the ***Calculations*** *tab*

In the area below the graph area, three single values can be shown. The options for these lines depend on the standard selected and the selection for the main spectrum -·- parameter.

The single values should be reported without decimals as shown in Fig. 4.40. This also indicates that the reference curve has been shifted with 1 dB increments during the calculation (as stated for all standards except NEN and NEN'06).

To estimate the uncertainty of the results, the reference curve can be shifted in increments of 0.1 dB – see setting *Ref. Curve Increment* on page 31.

For Airborne and Façade measurements the result values will be up to 0.9 dB higher than the result values calculated with 1 dB Ref. Curve Increment.

For Impact measurements the result values will be up to 0.9 dB lower than the result values calculated with 1 dB Ref. Curve Increment.

If the difference is close to zero, then the result is more sensitive to small changes in the measurement conditions.

A yellow smiley is set at the single result values when Ref. Curve Increment is set to 0.1 dB, to indicate that the increment is not set as stated by the standard for reporting results.

4.9 Quality Indicators

Building acoustics software offers a wide range of status indicators and smileys. They are listed in Table 4.3.

Table 4.4 *Overview of Status Indicators and Smileys*

Status Code	Smiley	Explanation	Description
M		Manual data input	RT entered by user
B		Maximum background noise correction used	High background noise
N		No decay end found	The end of the decay cannot be determined because it does not end in the background noise
y		Background noise too high	Background noise is above the upper evaluation point, consider making serial measurements at the frequency bands with high background noise, see section 4.4.8
t		No decay start found	No decay start found
Y		Background noise too high	Background noise is above the lower evaluation point, consider making serial measurements at the frequency bands with high background noise, see section 4.4.8
T		Maximum decay time too short	The lower evaluation point is beyond the decay time
Z		No decay found	The slope of the decay is positive, i.e., the reverberation time is negative
P		Reverberation time too short	Less than two points in evaluation range
O		Excitation sound level too high	Overload (or wrong L1 and L2 level range)
F		Short reverberation time	B×T below 16 (B = filter bandwidth and T = reverberation time of detector)
R		T20 used (T30 unavailable)	T20 used (T30 unavailable)
n		High background noise	Background noise too close to level at lower evaluation point, consider making serial measurements at the frequency bands with high background noise, see section 4.4.8
p		Short reverberation time	Less than four points in evaluation range

Table 4.4 *(Continued)Overview of Status Indicators and Smileys*

Status Code	Smiley	Explanation	Description
%		Decay is bent	The difference between T20 and T30 is greater than 10%. (Recommended quality indicator from ISO 3382-2 Annex B)
k		Decay is non-linear	Correlation coefficient in linear regression is too low (less than 0.005 or ξ (Xi) > 10%
b		Background noise correction used	Background noise correction used
m		Affected by manual input	Reverberation time entered by user
G		Receiving room volume limited in calculation	Used on the SS standard only
H		No B2 measurements available	No B2 measurements available
~		L1: >6 dB difference to adjacent band	Try other source or microphone positions, or change the optimisation of the frequency response for the internal generator (*Setup* menu, under *Generator L1 and L2*, *Sound Source* parameters), or make Serial measurements (*Setup* menu, *Measurement Control L1, L2 and B2*, *Level Measurement Mode*) and select the bands with a big difference for serial measurements (see section 4.4.8)
^		L1 or L2: High Standard Deviation	The standard deviation in a frequency band is greater than twice the theoretical expected value.
s		Measured serially	The frequency band has been measured using band-limited noise.
i		Ref. Curve Increment 0.1 dB	You should use Ref. Curve Increment 1 dB when reporting results

Table 4.4 *(Continued)Overview of Status Indicators and Smileys*

Status Code	Smiley	Explanation	Description
*		L1 or L2 (not both) measured serially	Make sure all positions in L1 and L2 are measured serially.
S		Not all positions measured serially	Make sure all positions for the function are measured serially.
L		No ISO 16283LF project is found An ISO 16283LF project is found, but the data are incomplete The L1 and L2 ISO 16283 **Generator** parameter is different from the ISO 16283LF parameter	Ensure that the **Calculations** > **LF Project** value is correct. Ensure that the Standard requirements have been met (see section 4.6). The ISO 16283 or ISO 16283LF measurement must be remade with the correct **Generator** parameter value.

If there is no status code, there is no smiley.

If any one of the status codes (there may be several) requires a red smiley, the red smiley will be displayed. If any one of the status codes requires a yellow smiley, but no red smiley, the yellow smiley will be displayed.

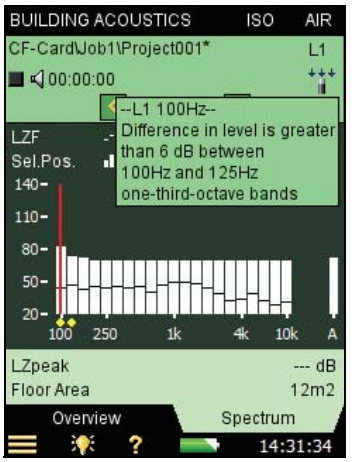
The explanation is shown if you tap on a smiley, see Fig.4.41.

Please note: Manual data input will overrule other smileys.

For the spectrum, small smileys are shown below the relevant frequency bands. Select the frequency band with the cursor and tap on the smiley in the cursor readout to see the explanation.

You can also view the spectrum table to get an overview of all the status codes, tap the y-axis and select *Spectrum Table* from the drop-down menu – see Fig.4.27.

Fig.4.41
Viewing smiley explanation



4.10 Creating a New Project

You create a new project by selecting a Building Acoustics template.

If you already have a Building Acoustics project open and no unsaved data, you can press the **Reset** pushbutton and create a new project based on the current project template.

4.11 Reusing Data from an Existing Project

With Explorer it is possible to copy one or more functions from one project to the current project.

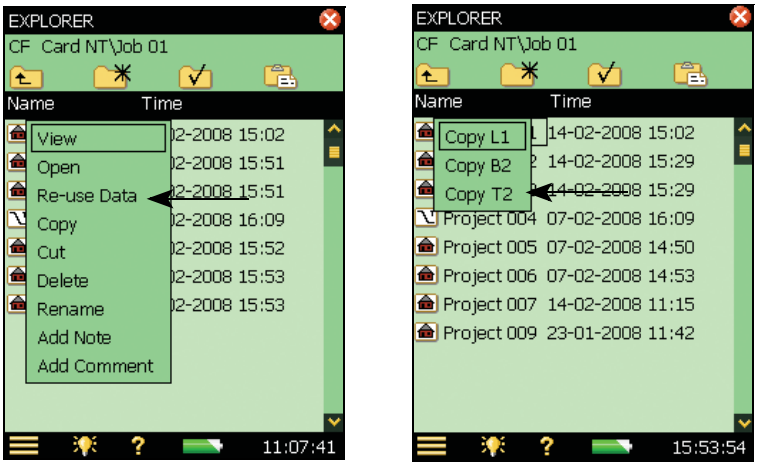
For example, if you want to reuse or copy T2 from Project 001 to the current project:

1) Ensure your current project is a building acoustics project (single or 2-channel).
2) Select Explorer to get a list of all projects.
3) Locate the Building Acoustics project from which you want to reuse data (in this example Project 001).
4) Tap on **Project 001** in the Explorer list and select **Reuse Data** from the drop-down list that appears, see Fig.4.42 (left).
5) A new drop-down list appears, showing the functions that are possible to reuse. Select **Copy T2** from the list, see Fig.4.42 (right). The function you copied (**T2**) appears in the current project.

Fig. 4.42
Re-using data

Left: Tapping on Project 001 in the Explorer list

Right: Selecting the function to copy into your project



Please note: If you are using the *Airborne* or *Façade* tasks, the following functions are available for copying:

- L1
- B2
- T2

If you are using the Impact task, only the following functions are available:

– B2

– T2

If the project already contains data for the function that you want to replace with reused data, then the reused function will overwrite the current data.

If the project already contains data for other functions, then the reused data you want to replace it with must match the data already there, e.g., the frequency range must be the same, otherwise you will get an error message.

4.12 Annotations and Signal Recording

4.12.1 Project Annotations

The project can be annotated like other types of projects by clicking on it (in Explorer) and using the **Add Note to current Measurement** option from the drop-down menu that appears, or by pressing the **Commentary** pushbutton. A **Paperclip** icon is displayed in the top line with access to the list of project annotations, see the example in Fig.4.43.

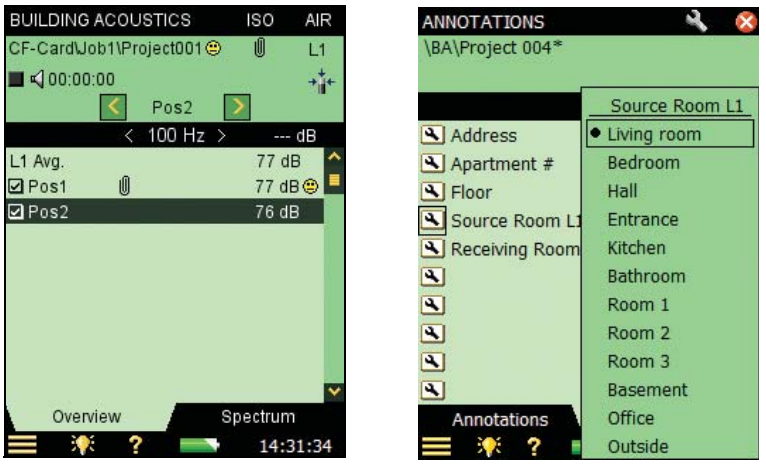


Fig.4.43
Example of an overview display showing annotations and/or signal recordings

4.12.2 Annotations on Measurement

In addition to the project annotation, you can annotate each measurement in the Overview. Tap the measurement in the Overview and select *View Annotations* for a list of annotations for the measurement in question. Using this list you can create, edit and delete annotations in the same way as you can on the Project Annotation list.

A selection of default metadata is included with the software in order to provide a starting point for metadata usage and cut down setup time.

Measurements with annotations are indicated by in the Overview display, and by (a smaller paperclip icon) on the **Overview** tab.

4.12.3 Adding Images to a Measurement

You can also attach an image (Type 2270 only). Similar to adding notes or comments, adding an image can also be done before, during or after saving the measurement by a tap > **Add Image** (to the current measurement) in the list of options. The Viewfinder display will then appear showing what is coming through the camera lens. The camera has fixed focus and automatically adjusts the light sensitivity; you just have to position the analyzer so that the object you want to capture is visible in the Viewfinder and press the **Manual Event** pushbutton or tap on the icon to capture the image.

When captured, the image is presented as a still picture (see Fig.4.44) and you can save the captured image by pressing the **Save** pushbutton (or by closing the Images view), or you can reject the image by pressing the **Back-erase** pushbutton.

Fig. 4.44
Example of an image used to document a measurement position

When finished, tap on the icon to return to the measurement screen. A **Paperclip** icon appears in the status field of the measurement and next to your project in Explorer. Tap to see a list of all annotations in the project, and tap in the annotation to view the image.

4.12.4 Signal Recording

If you record sound while making the measurements (**Recording Control** set to *Automatic* under **Signal Recording** parameters) then the sound recording is saved together with the annotations on each measurement. This is also indicated by on the **Overview** tab (in the line for the measurement) and (a small paperclip icon) in the **Overview** tab.

To capture images each time you press the **Manual Event** pushbutton, tap > **Preferences** > **Images** > **Image Control** and select *Manual Event*. (The *Viewfinder* setting displays what is coming through the camera lens).

Signal Recording is only possible in one channel. (It will be *Ch. 2* if the measurement is setup for a 2-channel measurement).

In the overview in Fig.4.43 there are annotations and/or a signal recording on the first measurement (*Pos1*). Tap to get a list of annotations and/or sound recordings attached to the measurement on *Pos1*.

4.13 Exporting, Post-processing and Reporting

Measurement Partner Suite BZ-5503 is used for all communication between PC and analyzer. Connect the analyzer to the PC using the supplied USB Cable.

Use this software to:

- Transfer measurement data and templates from the analyzer to your PC, and vice versa
- Control measurements on the analyzer from the PC and display them on-line using the same user interface on the PC as on the analyzer
- View Building Acoustics results in the Archives
- Edit the project templates
- Organise data on the analyzer
- Export your building acoustics projects from archives to Qualifier Type 7830 for further post-processing and for reporting
- Create users on the analyzer
- Upgrade software on the analyzer
- Install software licenses on the analyzer

Data transferred to the PC are organised in Archives.

For further information, please refer to the on-line help included with the relevant PC Software. This software is supplied on the Environmental Software CD-ROM (BZ-5298), which is included with the analyzer.

Chapter 5

Specifications

This chapter comprises the specifications that are needed for evaluation of instrument performance characteristics and proper use of the instrument. Some of the applicable sound level meter standards require additional technical documentation, in particular for pattern evaluation (type approval) purposes, but have no bearing on normal use. The additional technical documentation is given in a separate Brüel & Kjær instruction manual (BE 1712).

Specifications – Hand-held Analyzer Type 2250/2270 Platform

Microphone

SUPPLIED MICROPHONE
Type 4189: Prepolarized Free-field ½″ Microphone
or
Type 4190: Free-field ½″ Microphone
Nominal Open-circuit Sensitivity: 50 mV/Pa (corresponding to
−26 dB re 1 V/Pa) ± 1.5 dB
Capacitance: 14 pF (at 250 Hz)

MICROPHONE PREAMPLIFIER ZC-0032
Nominal Preamplifier Attenuation: 0.25 dB
Connector: 10-pin LEMO
Extension Cables: Up to 100 m in length between the microphone preamplifier and Type 2250/2270, without degradation of the specifications

MICROPHONE POLARIZATION VOLTAGE
Selectable between 0 V and 200 V

SELF-GENERATED NOISE LEVEL
Typical values at 23 °C for nominal microphone open-circuit sensitivity:

Weighting	Microphone	Electrical	Total
“A”	14.6 dB	12.4 dB	16.6 dB
“B”	13.4 dB	11.5 dB	15.6 dB
“C”	13.5 dB	12.9 dB	16.2 dB
“Z” 5 Hz–20 kHz	15.3 dB	18.3 dB	20.1 dB
“Z” 3 Hz–20 kHz	15.3 dB	25.5 dB	25.9 dB

Interface

KEYBOARD
Pushbuttons: 11 keys with backlight, optimized for measurement control and screen navigation

ON-OFF BUTTON
Function: Press 1 s to turn on; press 1 s to enter standby; press for more than 5 s to switch off

STATUS INDICATORS
LEDs: Red, amber and green

DISPLAY
Type: Transflective back-lit colour touch screen 240 × 320 dot matrix
Colour Schemes: Five different – optimized for different usage scenarios (day, night, etc.)
Backlight: Adjustable level and on-time

USER INTERFACE
Measurement Control: Using pushbuttons on keyboard
Setup and Display of Results: Using stylus on touch screen or pushbuttons on keyboard
Lock: Keyboard and touch screen can be locked and unlocked

USB INTERFACE
Hardware Versions 1 to 3: USB 1.1 OTG Mini B socket
Hardware Version 4:USB 2.0 OTG Micro AB and USB 2.0 Standard A sockets

MODEM INTERFACE
Connection to Internet through GPRS/EDGE/HSPA modem connected through:
- Compact Flash slot (hardware versions 1 – 3)
- USB Standard A Socket (hardware version 4)

Supports DynDNS for automatic update of IP address of host name

PRINTER INTERFACE
PCL printers, Mobile Pro Spectrum thermal printer or Seiko DPU S245/S445 thermal printers can be connected to USB socket

MICROPHONE FOR COMMENTARY
Microphone, which utilizes Automatic Gain Control (AGC), is incorporated in underside of analyzer. Used to create voice annotations for attaching to measurements

CAMERA (TYPE 2270 ONLY)
Camera with fixed focus and automatic exposure is incorporated in underside of analyzer
Used to create image annotations for attaching to measurements
Image Size:
- Hardware versions 1 – 3: 640 x 480 pixels
- Hardware version 4:2048 x 1536 pixels

Viewfinder Size: 212 x 160 pixels
Format: JPG with exif information
LAN INTERFACE SOCKET
Hardware Versions 1 to 3 (Type 2270 only)**:**
- Connector: RJ45 MDI
- Speed: 10 Mbps
- Protocol: TCP/IP

Hardware Version 4 (Types 2250 and 2270)**:**
- Connector: RJ45 Auto-MDIX
- Speed: 100 Mbps
- Protocol: TCP/IP

INPUT SOCKET (2 – TYPE 2270 ONLY)
Connector: Triaxial LEMO
Input Impedance: ≥ 1 MΩ
Direct Input: Max. input voltage: ± 14.14 V_{peak}
CCLD Input: Max. input voltage: ± 7.07 V_{peak}
CCLD Current/Voltage: 4 mA/25 V

TRIGGER SOCKET
Connector: Triaxial LEMO
Max. Input Voltage: ± 20 V_{peak}
Input Impedance: > 47 kΩ
Precision: ± 0.1 V

OUTPUT SOCKET
Connector: Triaxial LEMO
Max. Peak Output Level: ± 4.46 V
Output Impedance: 50 Ω

HEADPHONE SOCKET
Connector: 3.5 mm Minijack stereo socket
Max. Peak Output Level: ± 1.4 V
Output Impedance: 32 Ω in each channel

Power

EXTERNAL DC POWER SUPPLY REQUIREMENTS
Used to charge the battery pack in the analyzer
Voltage: 8 – 24 V DC, ripple voltage < 20 mV
Current Requirement: Min. 1.5 A
Power Consumption: < 2.5 W, without battery charging, < 10 W when charging
Cable Connector: LEMO Type FFA.00, positive at centre pin

EXTERNAL AC MAIN SUPPLY ADAPTOR
Part No.: ZG-0426
Supply Voltage: 100 – 120/200 – 240 V AC; 47 – 63 Hz
Connector: 2-pin IEC 320

BATTERY PACK
Part No.: QB-0061 Rechargeable Li-Ion battery
Voltage: 3.7 V
Capacity: 5200 mAh nominal
Typical Operating Time:
- Single-channel: > 11 h (screen backlight dimmed); > 10 h (full screen backlight)
- 2-channel: > 10 h (full screen backlight)

Use of external interfaces (LAN, USB, Wi-Fi) will decrease battery operating time
Battery Cycle Life: > 500 complete charge/discharge cycles
Battery Aging: Approximately 20% loss in capacity per year
Battery Indicator: Remaining battery capacity and expected working time may be read out in % and in time
Battery Fuel Gauge: The battery is equipped with a built-in fuel gauge, which continuously measures and stores the actual battery capacity in the battery unit
Charge Time: In analyzer, typically 10 hours from empty at ambient temperatures below 30 °C. To protect the battery, charging will be terminated completely at ambient temperatures above 40 °C. At 30 to 40 °C charging time will be prolonged. With external charger ZG-0444 (optional accessory), typically 5 hr
Note: It is not recommended to charge the battery at temperatures below 0 °C (32 °F) or over 50 °C (122 °F). Doing this will reduce battery lifetime

CLOCK
Back-up battery powered clock. Drift < 0.45 s per 24 hr period

Storage

INTERNAL FLASH-RAM (NON-VOLATILE)
For user setups and measurement data
- Hardware versions 1 – 3: 20 MB
- Hardware version 4: 512 MB

EXTERNAL SECURE DIGITAL MEMORY CARD
SD and SDHC Card: For store/recall of measurement data

EXTERNAL COMPACT FLASH MEMORY CARD (Hardware Versions 1 – 3 Only)
CF Card: For store/recall of measurement data

USB MEMORY STICK(Hardware version 4 only)
For store/recall of measurement data

Environmental

WARM-UP TIME
From Power Off: <2 minutes
From Standby: <10 seconds for prepolarized microphones

WEIGHT AND DIMENSIONS
650 g (23 oz) including rechargeable battery
300 × 93 × 50 mm (11.8 × 3.7 × 1.9") incl. preamplifier and microphone

User Interface

USERS
Multi-user concept with login. Users can have their own settings with jobs and projects totally independent of other users

PREFERENCES
Date, Time and Number formats can be specified per user

LANGUAGE
User Interface in Catalan, Chinese (People's Republic of China), Chinese (Taiwan), Croatian, Czech, Danish, English, Flemish, French, German, Hungarian, Japanese, Italian, Korean, Polish, Portuguese, Romanian, Russian, Serbian, Slovenian, Spanish, Swedish, Turkish and Ukranian

HELP
Concise context-sensitive help in Chinese (People's Republic of China), English, French, German, Italian, Japanese, Polish, Romanian, Serbian, Slovenian, Spanish and Ukranian

UPDATE OF SOFTWARE
Update to any version (from 4.0 and up) using BZ-5503, included, through USB or update via Internet:

REMOTE ACCESS
Connect to the analyzer using Measurement Partner Suite BZ-5503, using Measurement Partner Field App (iOS or Android smartphone app), using the 2250/2270 SDK (Software Development kit), using a REST interface through HTTP or using an Internet browser supporting JavaScript.
The connection is password protected
Two levels of protection:
- Guest level: for viewing only
- Administrator level: for viewing and full control of the analyzer

CLOUD
Connect to Measurement Partner Cloud on cloud.bksv.com for transferring data to an archive in the cloud for storage or easy synchronization with Measurement Partner Suite BZ-5503

Specifications – Building Acoustics Software BZ-7228

Specifications apply to BZ-7228 unless otherwise stated.
BZ-7229 2-channel Option is for Type 2270 only

STANDARDS
Conforms with the relevant parts of the following:
- IEC 61672 –1 (2013) Class 1
- IEC 60651 (1979) plus Amendment 1 (1993–02) and Amendment 2 (2000–10), Type 1
- ANSI S1.4–1983 plus ANSI S1.4A–1985 Amendment, Type 1
- IEC 61260–1 (2014), 1/1-octave Bands and 1/3-octave Bands, Class 1
- IEC 61260 (1995–07) plus Amendment 1 (2001–09), 1/1-octave Bands and 1/3-octave Bands, Class 0
- ANSI S1.11–1986, 1/1-octave Bands and 1/3-octave Bands, Order 3, Type 0–C
- ANSI S1.11–2004, 1/1-octave Bands and 1/3-octave Bands, Class 0
- ANSI/ASA S1.11–2014 Part 1, 1/1-octave Bands and 1/3-octave Bands, Class 1
- ISO 16283, ISO 140, SS, DIN, Önorm, BS, BREW, Sia, UNI, NF-S31, NBE, NEN, NEN'06, ASTM, see tables under "Building Acoustics Measurement Standards" on page 8

Note: The International IEC Standards are adopted as European standards by CENELEC. When this happens, the letters IEC are replaced with EN and the number is retained. Type 2250/2270 also conforms to these EN Standards

CHANNELS (TYPE 2270 ONLY)
All measurements are made from either Ch. 1 or Ch. 2 or both simultaneously

TRANSDUCERS
Transducers are described in a transducer database with information on Serial Number, Nominal Sensitivity, Polarization Voltage, Free-field Type, CCLD required, Capacitance and additional information. The analogue hardware is set up automatically in accordance with the selected transducer

CORRECTION FILTERS
For microphone Types 4189, 4190, 4191, 4193, 4950, 4952 and 4964, BZ-7228 is able to correct the frequency response to compensate for sound field and accessories

Broadband Analysis

DETECTORS
A- and C-weighted: Broadband detectors with Fast exponential time weighting
Overload Detector: Monitors the overload outputs of all the frequency weighted channels
Underrange Detector: Monitors the under range of all the frequency weighted detectors. Underrange is set if level is below lower limit of Linear Operating Range
Type 2270: Detectors available for both Ch. 1 and Ch. 2

MEASUREMENTS
L_{AF} and L_{CF} for Display as Numbers or Quasi-analogue Bars

MEASURING RANGES
When using Microphone Type 4189:
Dynamic Range: From typical noise floor to max. level for a 1 kHz pure tone signal, A-weighted:
Single Range: 16.6 to 140 dB
High Range: 28.5 to 140 dB
Low Range: 16.6 to 110 dB
Primary Indicator Range: In accordance with IEC 60651, A-weighted:
Single Range: 23.5 to 123 dB
High Range: 41.7 to 123 dB
Low Range: 23.5 to 93 dB
Linear Operating Range: In accordance with IEC 61672, A-weighted: 1 kHz:
Single Range: 24.8 to 140 dB
High Range: 43.0 to 140 dB
Low Range: 24.8 to 110 dB

Frequency Analysis

CENTRE FREQUENCIES
1/1-octave Band Centre Frequencies: 63 Hz to 8 kHz
1/3-octave Band Centre Frequencies: 50 Hz to 10 kHz

MEASURING RANGES
When using Microphone Type 4189:
Dynamic Range: From typical noise floor to max. level for a pure tone signal at 1 kHz 1/3-octave:
Single Range: 1.1 to 140 dB
High Range: 11.3 to 140 dB
Low Range: 1.1 to 110 dB
Linear Operating Range: In accordance with IEC 61260:
Single Range: ≤ 20.5 to 140 dB
High Range: ≤ 39.1 to 140 dB
Low Range: ≤ 20.5 to 110 dB

Internal Generator

Built-in pseudo-random noise generator
Spectrum: Selectable Pink or White
Crest Factor:
Pink Noise: 4.4 (13 dB)
White Noise: 3.6 (11 dB)
Bandwidth: Follows measurement frequency range
  Lower Limit: 50 Hz (1/3-oct.) or 63 Hz (oct.)
  Upper Limit: 10 kHz (1/3-oct.) or 8 kHz (oct.)
Output Level: Independent of bandwidth
  Max.: 1 V_{rms} (0 dB)
  Gain Adjustment: –80 to 0 dB
When bandwidth is changed, the level for all bands is automatically adjusted to comply with the set output level
Correction Filters: For sound sources Type 4292-L, Type 4295 and Type 4296: Flat or Optimum
Turn-on Time and Turn-off Time: Equivalent to RT = 70 ms
Repetition Period: 175 s
Output Connector: Output Socket
Control: See Measurement Control

External Generator

Selectable as alternative to Internal Generator
For controlling external noise generator
Levels: 0 V (Generator off), 3.3 V (Generator on)
Rise-time and Fall-time: 10 µs
Control: See Measurement Control

Measurements

Measurements are done at a number of positions and categorized in functions (L1 for Source Room levels, L2 for Receiving Room levels, B2 for Receiving Room Background noise levels and T2 for Receiving Room Reverberation Time measurements)

LEVELS L1, L2 AND B2
L_{ZF} spectrum for display only
L_{Zeq} in 1/1-octave or 1/3-octave bands
L1 and L2 simultaneously or as single channels
Averaging time: 1 s to 1 hr
Range (L1 and L2 simultaneously only): Autorange or manually set to High Range or Low Range
Averaging: Up to 10 source positions each with up to 10 measurement positions or up to 100 measurements may be averaged
Status Indications: Overload, under range, etc.
Crosstalk:
5 Hz – 10 kHz <–110 dB
10 kHz – 20 kHz <–100 dB

REVERBERATION TIME T2
T20 and T30 in 1/1-octave or 1/3-octave bands
Decays: L_{Zeq} spectra sampled at 5 ms intervals
Evaluation Range: –5 to –25 dB for T20 and –5 to –35 dB for T30
Measurement Time: Automatic selection of measurement time for the decays based on the actual reverberation time of the room
Maximum Measurement Time: From 2 to 20 s
Averaging: T20 and T30 measurements can be averaged (arithmetic averaging or ensemble averaging)
T20 and T30 Calculation: From slope in evaluation range
Slope Estimation: Least squares approximation
Quality Indicators: Quality indicators with status information like Overload, Curvature in %, etc.; extensive list of Status information
Quality Indicators are available on reverberation time spectra for each frequency band, and as overall quality indicators for each measurement position and for the averaged result
Reverberation Time Range: Max. 30 s, min. 0.1 – 0.7 s, depending on bandwidth and centre frequency
Manual Data Entry: A T2 value may be entered in any frequency band of a measured spectrum

Measurement Displays

OVERVIEW
Table of measurement positions for each function (L1, L2, B2 or T2) with readout for selectable frequency band on each position together with quality indicator.
Positions can be included/excluded from average

SOUND LEVEL SPECTRUM
LZF spectrum plus A and C broadband bars
L_{Zeq} spectrum for L1@Pos, L2@Pos, B2@Pos, L1, L2, B2, L1-L2, L2-B2
Y-axis: Range: 5, 10, 20, 40, 60, 80, 100, 120, 140 or 160 dB. Auto- zoom or auto scale available
Cursor: Readout of selected band quality indicator for each frequency band

REVERBERATION TIME SPECTRUM
One or two spectra can be displayed
Y-axis: Range: 0.5, 1, 2, 5, 10 or 20 s. Auto zoom available
Cursor: Readout of selected band quality indicator for each frequency band

SPECTRUM TABLE
One or two spectra can be displayed in tabular form

DECAY
Decay curve for a position or the room average available for each frequency band (if Ensemble Average selected)
Display of evaluation range and regression line
Readout of Curvature in %
Y-axis: Range: 5, 10, 20, 40, 60, 80, 100, 120, 140 or 160 dB. Auto zoom or auto scale available

Result Displays

OVERVIEW
Table of measurement positions for all functions (L1, L2, B2 or T2) with readout of quality indicators.
Positions can be included/excluded from result

CALCULATIONS
Shows the sound reduction index (spectrum and weighted) according to the selected standard, along with the reference curve (if any), or deviations (from the reference curve). See Table 2 on page 9

Measurement Control

Measurement Sequence: Supports measuring:
- at all microphone positions before using another source
- at a microphone position for all sources before measuring at a new position
- at subsequent microphone positions without source information
- at manually selected source and microphone positions

Measurements are started manually and can be automatically stored on completion of measurement
Generator (L1, L2 and T2): The noise generator is turned on and off automatically
Escape Time: 0 to 60 s
Build-up Time: 1 to 10 s
The generator can be turned on and off manually for checking equipment and sound levels

EXCITATION T2
Interrupted Noise: Measurements are started manually and can be automatically stored on completion of measurement
Number of Decays per Measurement: 1 to 100, ensemble averaged into one decay
Impulse: Manual start of first measurement. When level (say from starter pistol) exceeds the user-selected trigger level, the decay is recorded and backwards integration performed (Schroeder method). The trigger can then be armed automatically for measuring at the next position
Signal Recording: Recording of the Z-weighted measured signal can be done at each position*

Measurement Status

On Screen: Information such as *overload*, *awaiting trigger* and *running/paused* are displayed on screen as icons or text

* Signal recording requires an SD card or USB stick for data storage and a license for Signal Recording Option BZ-7226

Traffic Light: Red, yellow and green LEDs show measurement status and instantaneous overload as follows:
- Yellow LED flashing every 5 s = stopped, ready to measure
- Green LED flashing slowly = awaiting trigger or calibration signal
- Green LED on constantly = measuring
- Yellow LED flashing slowly = paused, measurement not stored
- Red LED flashing quickly = intermittent overload, calibration failed

Calibration

Initial calibration is stored for comparison with later calibrations
Acoustic: Using Sound Calibrator Type 4231 or custom calibrator. The calibration process automatically detects the calibration level when Sound Calibrator Type 4231 is used
Electrical: Uses internally generated electrical signal combined with a typed-in value of microphone sensitivity
Calibration History: Up to 20 of the last calibrations made are listed and can be viewed on the instrument

Signal Monitoring

Input signal A-, C- or Z-weighted can be monitored using an earphone/headphones connected to the headphone socket
Headphone Signal: Input signal can be monitored using this socket with headphones/earphones
Gain Adjustment: –60 dB to 60 dB

Voice Annotations

Voice annotations can be attached to the building acoustics project and to measurements at each position
Playback: Playback of voice annotations or signal recordings can be listened to using earphone/headphones connected to the headphone socket
Gain Adjustment: –60 to 0 dB

Text and Image Annotations

Text and image (Type 2270 only) annotations can be attached to the building acoustics project and to measurements at each position

Data Management

Project Template: Defines the display and measurement setups
Project: Measurement data for all positions defined in source room (L1) and in receiving room (L2, B2 and T2) are stored with the Project Template
Re-use of data: Data for L1, B2 or T2 in one project can be re-used in another project
Job: Projects are organized in Jobs
Explorer facilities for easy management of data (copy, cut, paste, delete, rename, view data, open project, create job, set default project name)

Software Specifications – Measurement Partner Suite BZ-5503

BZ-5503 is included with Types 2250, 2270 and 2250 Light (referred to as Type 2250/70 here) for easy synchronization of setups and data between the PC and hand-held analyzer. BZ-5503 is supplied on ENV DVD BZ-5298

PC REQUIREMENTS
Operating System: Windows® 7, 8 or 8.1 (all in 32-bit or 64-bit versions)
Recommended PC:
- Intel® Core™ i3
- Microsoft®.NET 4.5
- 2 GB of memory
- Sound card
- DVD drive
- At least one available USB port
- Solid State Drive

ON-LINE DISPLAY OF TYPE 2250/2270 DATA
Measurements on Type 2250/2270 can be controlled from the PC and displayed on-line with the PC, using the same user interface on the PC as on Type 2250/2270
Display: 1024 × 768 (1280 × 800 recommended)

DATA MANAGEMENT
Explorer: Facilities for easy management of analyzers, Users, Jobs, Projects and Project Templates (copy, cut, paste, delete, rename, create)
Data Viewer: View measurement data (content of projects)
Synchronization: Project Templates and Projects for a specific user can be synchronized between PC and Type 2250/2270 and between local and cloud archives..
Measurement Partner Suite BZ-5503 merges Measurement Partner Field App annotations with the corresponding analyzer project

USERS
Users of Type 2250/2270 can be created or deleted

EXPORT FACILITIES
Excel®: Projects (or user-specified parts) can be exported to Microsoft® Excel® (Excel 2003 – 2010 supported)

Brüel & Kjær Software: Projects can be exported* to Predictor-LimA Type 7810, Acoustic Determinator Type 7816, Evaluator Type 7820, Protector Type 7825 or Qualifier (Light) Type 7830 (7831)

POST-PROCESSING
Measurement Partner Suite is a suite of modules, including post-processing tools for data acquired with Type 2250/2270. The following post-processing modules are available:
- Logging Module BZ-5503-A
- Spectrum Module BZ-5503-B
- WAV File Analysis Module BZ-5503-C

These modules help to assess logging data and measured spectra, such as calculating contribution from markers on a logging profile or correcting spectra for background noise

* Not all data are available in all exports. The data exported are dependent on the type and target of the export.

TYPE 2250/2270 SOFTWARE UPGRADES AND LICENSES
The software controls Type 2250/2270 software upgrades and licensing of the Type 2250/2270 applications

INTERFACE TO TYPE 2250/2270
USB, LAN or Internet connection
USB Connection:
- Hardware versions 1 – 3: USB ver. 1.1
- Hardware version 4: USB ver. 2.0

LICENSE MOVER
To move a license from one analyzer to another use BZ-5503, together with License Mover VP-0647

LANGUAGE
User Interface in Chinese (People's Republic of China), Chinese (Taiwan), Croatian, Czech, Danish, English, Flemish, French, German, Hungarian, Japanese, Italian, Korean, Polish, Portuguese, Romanian, Russian, Serbian, Slovenian, Spanish, Swedish, Turkish and Ukrainian

HELP
Concise context-sensitive help in English

Specifications – Signal Recording Option BZ-7226

Signal Recording Option BZ-7226 is enabled with a separate license. It works with all the software for Type 2250/2270: Sound Level Meter, Frequency Analysis, Logging Software, Enhanced Logging Software and Reverberation Time Software
For data storage, Signal Recording requires either:
- SD Card
- CF Card: Hardware versions 1 – 3
- USB Memory Stick: Hardware version 4

RECORDED SIGNAL
A-, B-, C- or Z-weighted signal from the measurement transducer

AUTOMATIC GAIN CONTROL
The average level of the signal is kept within a 40 dB range, or the gain can be fixed

PLAYBACK
Playback of signal recordings can be listened to using the earphone/headphones connected to the headphone socket

SAMPLING RATE AND PRE-RECORDING
The signal is buffered for the pre-recording of the signal. This allows the beginning of events to be recorded even if they are only detected later.

Sampling Rate (kHz)	Maximum Pre-recording (s)	Sound Quality	Memory (KB/s)
8	70	Low	16
16	230	Fair	32
24	150	Medium	48
48	70	High	96

RECORDING FORMAT
The recording format is 16- or 24-bit wave files (extension .WAV) attached to the data in the project, easily played-back afterwards on a PC using BZ-5503. Calibration information is stored in the .WAV file, allowing PULSE to analyse the recordings

Specifications – Qualifier Type 7830

STANDARDS
See Tables 1 and 2 under "Building Acoustics Measurement Standards" on page 8

LANGUAGES
English, French, German, Italian and Spanish

VIEWS
Result Level Views: A collection of views showing the resulting single values, reduction curve and underlying average curves (L1, L2, B2 and T20/T30)
Average Level Views: Each of the parameters (L1, L2 and B2) has a corresponding view showing all of the measurement curves included in the average calculation and a view of the resulting average curve.
In T20/T30 Average mode, it is possible to see all of the T20/T30s included in the average calculation. In Ensemble Average mode, it is possible to see the averaged 3D and averaged single frequency decay curves. Both modes gives the user the ability to see the resulting T20/T30 spectrum
Position Level Views: Each of the level measurements (L1, L2 and B2) can be viewed as a spectrum. In addition, the T2 reverberation measurement can be viewed as 3D-multispectra and as single frequency decay curves. Furthermore it is possible to see the calculated T20/T30 spectrum
Data Sheets: All of the measurement and the most relevant intermediate and final results can be viewed as values in a table (not decays)

CURSOR READ-OUT
All curves have cursor read-out

MANUAL INPUT
Allows graphical input and modification of the regression line in reverberation decay curves. Calculated sound reduction curves can also be adjusted graphically (The impact on the single value index is shown simultaneously). To give maximum flexibility, position, average and calculated data can be overridden by manually inputting data in the data sheets

CALCULATIONS
Supports calculation of insulation and reverberation tasks. Insulation calculations include airborne and impact sound insulation (lab/field). In addition, airborne facade calculation is supported.

REPORT GENERATION
Based on document templates it is possible to make reports conforming to the supported standards

OUTPUT
Relevant views and sheets can be printed or exported to the clipboard. Text or graphs may be transferred to word processors in RTF (Rich Text Format)

HELP
Online context-sensitive and user guide

DATA TRANSFER
- Via USB using Measurement Partner Suite BZ-5503

MINIMUM PC
- Windows® 7, 8 or 8.1 (all in 32-bit or 64-bit versions)
- Intel® Core™ i3
- 2 GB RAM
- Sound card
- DVD drive
- Mouse

Ordering Information

BUILDING ACOUSTICS KITS
The following kits are designed to provide Type 2250 and Type 2270 users with the necessary accessories to perform single-channel building acoustics measurements:

BZ-7228-200 Building Acoustics Kit for single-channel airborne sound insulation, including:

- BZ-7228: Building Acoustics Software (includes Reverberation Time Software BZ-7227)
- Type 2734-A: Power Amplifier
- Type 4292-L: OmniPower Sound Source (tripod and carrying bag KE-0462 included)
- AO-0523-D-100: Signal Cable, Triaxial LEMO to XLR3M, 10 m (33 ft)
- AQ-0673: Speaker Cable, speakON® 4-pin (M) to speakON 4-pin (M),10 m (33 ft)
  Note: Flight case KE-0449 for OmniPower sound source must be purchased separately
- KE-0364: Carrying bag for Type 4292-L Tripod
- UA-0801: Tripod for Type 2250

BZ-7228-300 Building Acoustics Kit for single-channel airborne or impact sound insulation, including the same items as BZ-7228-200 and:

- Type 3207: Tapping Machine
- UA-1477: Battery Kit for Type 3207

Type 2270 users (not Type 2250 users) can upgrade a BZ-7228-200 or BZ-7228-300 kit to perform 2-channel building acoustics measurements with a combination the following accessories, depending on your measurement scenario:

- BZ-7229: 2-Channel Option
- Type 4189: Prepolarized Free-field ½″ Microphone
- AO-0697-D-100: Microphone Extension Cable, 10-pin LEMO,
  10 m (33 ft)
- AR-0199: Flat Cable, 10-pin LEMO, 0.5 m (1.64 ft)
- JP-1041: Dual 10-pole Adaptor Cable
- UA-0801: Lightweight Tripod
- UA-1317: ½″ Microphone Holder
- ZC-0032: Microphone Preamplifier

For help determining the type and quantity of required accessories, please contact your local Brüel & Kjær sales representative

Software and Accessories Available Separately

SOftware Modules

BZ-7228	Building Acoustics Software for Types 2250 and 2270
BZ-7228-100	Upgrade of BZ-7227 Reverberation Time software to BZ-7228 Building Acoustics Software
BZ-7229	2-channel Option Type 2270
BZ-7223	Frequency Analysis Software
BZ-7224	Logging Software
BZ-7225	Enhanced Logging Software
BZ-7225-UPG	Upgrade from Logging Software BZ-7224 to Enhanced Logging Software BZ-7225 (does not include memory card)
BZ-7226	Signal Recording Option
BZ-7227	Reverberation Time Software
BZ-7230	FFT Analysis Software
BZ-7231	Tone Assessment Option
BZ-7234	Low Frequency Option

PC SOFTWARE

BZ-5503-A	Measurement Partner Suite, Logging Module
BZ-5503-B	Measurement Partner Suite, Spectrum Module
BZ-5503-C	Measurement Partner Suite, WAV file analysis module
Type 7830	Qualifier

MEASUREMENT ACCESSORIES

Type 3923	Rotating Microphone Boom
Type 4231	Sound Level Calibrator
AO-0440-D-015	Signal Cable, LEMO to BNC, 1.5 m (5 ft)
AO-0646	Sound Cable, LEMO to Minijack, 1.5 m (5 ft)
AO-0697-030	Microphone Extension Cable, 10-pin LEMO, 3 m (10 ft)
AO-0697-100	Microphone Extension Cable, 10-pin LEMO, 10 m (33 ft)
AR-0199	Flat Cable, 10-pin LEMO, 0.5 m (1.64 ft)
JP-1041	Dual 10-pole Adaptor
KE-0449	Flight case for OmniPower Sound Source Type 4292-L
UA-0587	Tripod
UA-0801	Lightweight Tripod
UA-1317	½″ Microphone Holder
UA-1404	Outdoor Microphone Kit
UA-1476	Wireless Remote Control Unit

UL-0256	Wireless Audio System kit, B&K specified
UL-0256-A	Wireless Audio System (AKG WMS 470 Set, RF Band VII-50 mW)
UL-1009	SD Memory Card for Hand-held Analyzers
UL-1013	CF Memory Card for Hand-held Analyzers, for hardware versions 1 – 3
UL-1017	SDHC Memory Card for Hand-held Analyzers
ZG-0444	Charger for Battery Pack QB-0061

Brüel & Kjær supplies a wide range of microphones and microphone accessories. Please contact your local Brüel & Kjær office for more information regarding the different types and their use, or visit the website at www.bksv.com.

INTERFACING

BZ-5503-D	Measurement Partner Field App for iOS and Android (free download at App Store and Play)
BZ-5503-E	Measurement Partner Cloud entry level, free cloud storage
BZ-5503-F-012	Measurement Partner Cloud basic, basic cloud storage subscription for one year
BZ-5503-G-012	Measurement Partner Cloud professional, enterprise cloud storage subscription for one year
AO-1449-D-010	LAN Cable
UL-0250	USB to RS–232 Converter
UL-1050	Micro USB Wi-Fi dongle

SOUND SOURCES

Type 4292-L	OmniPower Sound Source
Type 4295	OmniSource Sound Source
Type 3207	Tapping Machine
Type 2734-A	Power Amplifier
Type 2734-B	Power Amplifier with Wireless Audio System UL-0256

For further information please refer to the Sound Sources for Building Acoustics product data, BP 1689

Type 4224	Portable Battery & Mains Powered Sound Source

For further information please refer to the Sound Source Type 4224 product data, BP 0066

Service Products

accredited Calibration

2250-J-CEI	Initial Calibration
2250-J-CEF	Periodic Calibration
2270-K-CEI	Initial Calibration
2270-K-CEF	Periodic Calibration

HARDWARE MAINTENANCE

2250/2270-EW1	Extended Warranty, one year extension (Types 2250/2270)

Compliance with Environmental Standards

	The CE marking is the manufacturer's declaration that the product meets the requirements of the applicable EU directives RCM mark indicates compliance with applicable ACMA technical standards – that is, for telecommunications, radio communications, EMC and EME China RoHS mark indicates compliance with administrative measures on the control of pollution caused by electronic information products according to the Ministry of Information Industries of the People's Republic of China WEEE mark indicates compliance with the EU WEEE Directive
Safety	EN/IEC 61010–1, ANSI/UL 61010–1 and CSA C22.2 No.1010.1: Safety requirements for electrical equipment for measurement, control and laboratory use
EMC Emission	EN/IEC 61000–6–3: Generic emission standard for residential, commercial and light industrial environments EN/IEC 61326: Electrical equipment for measurement, control and laboratory use – EMC requirements CISPR 22: Radio disturbance characteristics of information technology equipment. Class B Limits IEC 61672–1, IEC 61260, IEC 60651 and IEC 60804: Instrumentation standards **Note:** The above is only guaranteed using accessories listed in this Product Data
EMC Immunity	EN/IEC 61000–6–2: Generic standard – Immunity for industrial environments EN/IEC 61326: Electrical equipment for measurement, control and laboratory use – EMC requirements IEC 61672–1, IEC 61260, IEC 60651 and IEC 60804: Instrumentation standards **Note:** The above is only guaranteed using accessories listed in this Product Data
Temperature	IEC 60068–2–1 & IEC 60068–2–2: Environmental Testing. Cold and Dry Heat. Operating Temperature: –10 to +50 °C (14 to 122 °F) Storage Temperature: –25 to +70 °C (–13 to 158 °F)
Humidity	IEC 60068–2–78: Damp Heat: 93% RH (non-condensing at +40 °C (104 °F)). Recovery time 2 ~ 4 hours
Mechanical	Non-operating: IEC 60068–2–6: Vibration: 0.3 mm, 20 m/s^2, 10 – 500 Hz IEC 60068–2–27: Bump: 1000 bumps at 400 m/s^2 IEC 60068–2–27: Shock: 1000 m/s^2, 6 directions
Enclosure	IEC 60529 (1989): Protection provided by enclosures: IP44*

* With preamplifier, extension cable or protection plug connected to the top socket and the hinged cover protecting the bottom connectors

Appendix A

Setup Parameters

This appendix describes all the setup parameters included in a template. The parameters are applicable to Types 2250 and 2270, unless otherwise stated.

A.1 Input (For Type 2270 Only)

Table A.1 *Input parameters*

Parameter	Values	Comment
Measure L1 and L2	*Simultaneously* *Separately*	**Please note:** If **Task** = *Façade* and **Generator Type** = *Off* (Traffic Noise) then *Simultaneously* is the only option. This parameter requires a BZ-7229 license
Input for L1	*Ch. 1* *Ch. 2* *Ch. 1 and Ch. 2*	Select input channel for L1 measurements. **Please note:** If **Measure L1 and L2** = *Simultaneously* then *Ch.1* is the only option. *Ch. 1 and Ch. 2 Simult.* requires a BZ-7229 license
Input for L2	*Ch. 1* *Ch. 2* *Ch. 1 and Ch. 2*	Select input channel for L2 measurements. **Please note:** If **Measure L1 and L2** = *Simultaneously* then *Ch. 2* is the only option. *Ch. 1 and Ch. 2 Simult.* requires a BZ-7229 license
Input for B2	*Ch. 1* *Ch. 2* *Ch. 1 and Ch. 2*	Select input channel for B2 measurements. *Ch. 1 and Ch. 2 Simult.* requires a BZ-7229 license
Input for T2	*Ch. 1* *Ch. 2* *Ch. 1 and Ch. 2*	Select input channel for T2 measurements. *Ch. 1 and Ch. 2 Simult.* requires a BZ-7229 license
Autorange	*Off* *On*	Set to *On* for autoranging Ch.1 and Ch.2 or set to *Off* for manually setting the range. This is relevant for **Measure L1 and L2** = *Simultaneously* or for **Input** set to *Ch.1 and Ch.2 Simult.* requires a BZ-7229 license

A.2 Input

Table A.2 *Input parameters*

Parameter	Values	Comment
Input	*Top Socket* *Rear Socket*	Determines whether the input is taken from the top socket or the rear socket (Input' on connector panel). Connect your transducer to this socket **Please note: Sound Field** and **Windscreen** corrections can be added to both the *Top Socket* and the *Rear Socket* (**Input** parameters)
Sound Field Correction	*Free-field* *Diffuse-field*	Select a correction matching the sound field of your measurements, i.e., you can make correct measurements in a diffuse field using a Type 4189 free-field microphone, by selecting *Diffuse-field* correction. Building Acoustics measurements require the *Diffuse-field* setting. No correction is made for unknown transducers
Windscreen Auto Detect	*On* *Off*	Automatic detection of UA-1650 windscreen when mounted on the ZC-0032 microphone preamplifier. The preamplifier should be connected to the top socket, if necessary using a microphone extension cable. This parameter is only available for microphone types using ZC-0032
Windscreen Correction	*None* *UA-1650* *UA-1404*	If *Windscreen Auto Detect* is set to *Off*, you can manually select a windscreen correction suitable for the windscreen in use. Correction is automatically made for the windscreen on Type 4952. No correction is made for unknown transducers
Range Setting	*High Range* *Low Range*	Set **Range Setting** to *High Range* or *Low Range* as required. The difference between the two settings is 30 dB. *High Range* can be used to measure up to the max. input level. This setting is relevant for **Measure L1 and L2** = *Simultaneously* and **Autorange** = *Off*, or for **Input** set to *Ch.1* and *Ch.2* and **Autorange** = *Off* (Type 2270 only and requires a BZ-7229 license)

A.3 Standard

Table A.3 *Standard parameters*

Parameter	Values	Comment
Standard	*ISO 16283* *ISO 16283LF* *SS* *DIN* *ÖNORM* *BS* *BREW* *SIA* *UNI* *NF* *NBE* *CTE* *NEN* *NEN'06* *ASTM* *ISO 140*	
Task	*Airborne* *Impact* *Façade*	

A.4 Frequency Range

Table A.4 *Frequency Range parameters*

Parameter	Values	Comment
Bandwidth	*1/1-octave* *1/3-octave*	Bandwidth of frequency analysis
Bottom Frequency	*50 Hz to Top Frequency*	1/1-octave: 63 Hz – 8 kHz 1/3-octave: 50 Hz – 10 kHz **Please note:** The settings of **Bottom** and **Top Frequency** control the frequency range of the frequency analysis and the internal noise generator.
Top Frequency	*Bottom Frequency to 10 kHz*	1/1-octave: 63 Hz – 8 kHz 1/3-octave: 50 Hz – 10 kHz

The Frequency Range parameters are automatically set in accordance with the chosen standard; however, the range can be set wider than that required by the standard.

A.5 Measurement Control L1, L2 and B2

Table A.5 *Measurement Control L1, L2 and B2 parameters*

Parameter	Values	Comment
Planned Measurement	*Off* *On*	For **Planned Measurement** = *On*, you can define the number of source positions and microphone positions per source – otherwise the measurements are made from *Pos. 1* and forward
No. Of Source Positions	*1* to *10*	Only for **Planned Measurement** = *On*
L1: No. of Micr. Pos. per Source	*1* to *10*	Only for **Planned Measurement** = *On* The number can be increased after the first measurements have been saved – but not decreased below the last measurement position
L2: No. of Micr. Pos. per Source	*1* to *10*	Only for **Planned Measurement** = *On* The number can be increased after the first measurements have been saved – but not decreased below the last measurement position
Increment	*Source First* *Mic. Position First* *Manually*	Only for **Planned Measurement** = *On* Defines the order in which you want to do your measurements
Preset Time	*00:00:00* to *01:00:00*	
Automatic Save	*Off* *On*	
Level Measurement Mode	*Parallel* *Serial* *Combined*	*Parallel* measures all bands in the Spectrum simultaneously, *Serial* measures selected bands, and *Combined* first measures Parallel and then Serial in an automated sequence

A.6 Measurement Control T2

Table A.6 *Measurement Control T2 parameters*

Parameter	Values	Comment
Planned Measurement	*Off* *On*	For **Planned Measurement** = *On*, you can define the number of source positions and microphone positions per source – otherwise the measurements are made from *Pos. 1* and forward
No. Of Sources (Positions)	*1* to *10*	Only for **Planned Measurement** = *On*
No. of Micr. Pos. per Source	*1* to *10*	Only for **Planned Measurement** = *On* The number can be increased after the first measurements have been saved, but not decreased below the last measurement position
Increment	*Source First* *Mic. Position First* *Manually*	Only for **Planned Measurement** = *On* Defines the order in which you want to do your measurements
Max. Decay Time	*2 s* to *20 s*	The decay is based on spectra sampled every 5 ms. An algorithm determines when the decay is finished and then stops the measurement. Under difficult measurement conditions where the automatic stop cannot be found, **Max. Decay Time** determines when to stop
Automatic Save	*Off* *On*	
Excitation	*Impulsive* *Interrupted Noise*	
Number of Decays	*1* to *100*	Parameter only available if **Excitation** = *Interrupted Noise*
Trigger Level	*0* to *140 dB*	Parameter only available if **Excitation** = *Impulsive*
Trigger Repeat	*Off* *On*	Parameter only available if **Excitation** = *Impulsive*
T2 Measurement Mode	*Parallel* *Serial* *Combined*	*Parallel* measures all bands in the Spectrum simultaneously, *Serial* measures selected bands, and *Combined* first measures Parallel and then Serial in an automated sequence

A.7 Signal Recording

Table A.7 *Signal Recording parameters**

Parameter	Values	Comment
Recording Control	*Off* *Automatic*	Determines how recording of the measured signal is controlled. Set to *Automatic* to start the recording when the measurement is started and record throughout the measurement
Recording Quality	*Low* *Fair* *Medium* *High*	This setup determines the quality of the recording by adjusting the sampling rate. The amount of space required for the recording will depend on the selected quality: Quality — Sampling freq. — UpperMemory freq.16-bit *Low* 8 kHz 3 kHz16 KB/s *Fair* 16 kHz 6 kHz32 KB/s *Medium* 24 kHz 10 kHz48 KB/s *High* 48 kHz 20 kHz96 KB/s
Peak Recording Level	*145 dB* *135 dB* *125 dB* *115 dB* *105 dB* *95 dB* *85 dB* *75 dB*	The recorded signal is stored as a 16-bit wave file, which has a dynamic range of up to 96 dB. When playing back on Type 2250, the dynamic range of the output is approximately 75 dB. When playing back on a PC, it might be even lower. Set **Peak Recording Level** to fit the signal. The values for **Peak Recording Level** take the sensitivity of the attached transducer into account. The values shown in the list here are nominal values for a Type 4189 microphone

* Requires license for Signal Recording Option BZ-7226.

A.8 Generator for L1 and L2

Table A.8 *Generator for L1 and L2 Parameters*

Parameter	Values	Comment
Generator Type	*Internal* *External* *Off (Traffic Noise)*	Set to *Internal* to use the internal noise generator as specified below. Set to *External* to switch an external generator on/off using a logic signal: On = 3.3 V; Off = 0 V. The generator signal appears at the Output Socket. **Please note:** If **Task** = *Façade* and **Measure L1 and L2** = *Simultaneously*, then **Generator Type** = *Off (Traffic Noise)* will set the analyzer for averaging the differences L1 – L2 (BZ-7229 only)
Noise Type	*Pink* *White*	The type of noise from the internal generator. The bandwidth of the noise will be adjusted to the frequency range from **Bottom Frequency** to **Top Frequency**
Level [re. 1 V]	*–80.0* to *0.0 dB*	This sets the internal noise generator attenuation in dB, referenced to 1 V. This level stays at the set level irrespective of the frequency range
Escape Time	*0* to *60 s*	Set the **Escape Time** to allow the operator to leave the room before the generator is turned on and the measurement starts
Build-up Time	*1* to *10 s*	Set **Build-up Time** to allow the sound pressure in the room to settle after the sound source is switched on
Sound Source	*Unknown* *Type 4292 Optimum* *Type 4295 Optimum* *Type 4296 Optimum* *Type 4292 Flat* *Type 4295 Flat* *Type 4296 Flat*	This setting optimizes the frequency response of the internal generator output to the connected sound source. The 'Flat' setting optimizes the output for a flat power response, and the 'Optimum' setting optimizes the power difference between adjacent 1/1- or 1/3-octave bands while maintaining a 'boost' at low frequencies. Select a type matching your sound source: Type 4292 or 4296 OmniPower Sound Source Type 4295 OmniSource Sound Source Select *Unknown* if you are using another sound source, or do not want to correct the frequency response

A.9 Generator for T2

Table A.9 *Generator for T2 Parameters*

Parameter	Values	Comment
Generator Type	*Internal* *External*	Set to *Internal* to use the internal noise generator as specified below. Set to *External* to switch an external generator on/off using a logic signal: On = 3.3 V; Off = 0 V. The generator signal appears at the Output Socket. **Please note:** Set **Measurement Control** > **Excitation** = *Interrupted Noise* to enable the generator parameters
Noise Type	*Pink* *White*	The type of noise from the internal generator. The bandwidth of the noise will be adjusted to the frequency range from **Bottom Frequency** to **Top Frequency**
Level [re. 1 V]	*–80.0* to *0.0 dB*	This sets the internal noise generator attenuation in dB, referenced to 1 V. This level stays at the set level irrespective of the frequency range
Escape Time	*0* to *60 s*	Set the **Escape Time** to allow the operator to leave the room before the generator is turned on and the measurement starts

Table A.9 *(Cont.)Generator for T2 Parameters*

Parameter	Values	Comment
Build-up Time	*1* to *10 s*	Set the **Build-up Time** to allow the sound pressure in the room to settle after the sound source is switched on
Sound Source	*Unknown* *Type 4292 Optimum* *Type 4295 Optimum* *Type 4296 Optimum* *Type 4292 Flat* *Type 4295 Flat* *Type 4296 Flat*	This setting optimizes the frequency response of the internal generator output to the connected sound source. The 'Flat' setting optimizes the output for a flat power response, and the 'Optimum' setting optimizes the power difference between adjacent 1/1- or 1/3-octave bands, while maintaining a 'boost' at low frequencies. Select a type matching your sound source: Type 4292 or 4296 OmniPower Sound Source Type 4295 OmniSource Sound Source Select *Unknown* if you are using another sound source, or do not want to correct the frequency response

A.10 Geometry

Table A.10 *Geometry Parameters*

Parameter	Values	Comment
Source Room Vol. V1	*0.1* to *100000 m^3*	Needed for report in some standards and is a determinant for whether you need to do special low frequency measurements following the ISO 16283 standard, see section 4.6.
Source Room Floor Area	*0.1* to *10000 m^2*	Used to determine quality of L1 measurements
Partition Area S	*0.1* to *1000 m^2*	Used in calculation of results
Receiving Room Vol. V2	*0.1* to *100000 m^3*	Used in calculation of results and is a determinant for whether you need to do special low frequency measurements following the ISO 16283 standard, see section 4.6.
Receiving Room Floor Area	*0.1* to *10000 m^2*	Used to determine quality of L2 measurements

A.11 Calculations

Table A.11 *Calculation Parameters*

Parameter	Values	Comment
LF Project	Text entry	Enter the ISO 16283LF project name
Ref. Curve Increment	*0.1 dB* *1 dB*	Set **Ref. Curve Increment** to 1 dB to shift the reference curve in steps of 1 dB when calculating the result parameters. This is the recommended way of operation for reporting correct result parameters as required by the standard. Set **Ref. Curve Increment** to 0.1 dB to shift the reference curve in steps of 0.1 dB when calculating the result parameters. This is the recommended way of estimating the uncertainty of the results. Results are displayed with 0.1 dB resolution. **Please note:** The parameter has no effect for NEN and NEN'06 standards
Ensemble Averaging	*No* *Yes*	Set to *Yes* to average each of the position decays into an average decay (called the ensemble average or Room average). The averaged decays of the room can then be displayed in the Decay View. T20 and T30 will be calculated from the Room average. Set to *No* for no ensemble averaging. There will be no decays available for the room. T20 and T30 will be calculated as averages of the T20@Pos and the T30@Pos resp. for all the positions
Receiving Room Volume	*0.1* to *100 000 m^3*	Used in calculation of results
Partition Area S	*0.1*to *1000 m^2*	Used in calculation of results
T0	*0.01* to *10 s*	The reference reverberation time – typically 0.5 s, but it may vary with standards

Table A.11 *(Cont.)Calculation Parameters*

Parameter	Values	Comment
Calculate Using	*T30* *T20*	Use this parameter to specify which of the measured reverberation time values to use in the calculations. If T30 is specified and available, then T30 is used, otherwise, T20 is used
Correct for Background Noise	*Yes* *No*	Use this parameter to specify whether L2 should be corrected for the background noise B2 or not
L1: Check 6 dB Rule	*Yes* *No*	Select *Yes* if you want to check whether the sound spectrum in the source room has differences in level greater than 6 dB between adjacent 1/3-octave bands, or not. The check is done according to the method specified in ISO 140-4:1998, 6.2. If a difference greater than 6 dB is found, then the bands are marked with a yellow smiley. When the smiley is tapped, the following explanation appears: *L1: >6 dB difference to adjacent band*
L1, L2: Check Std. Deviation	*Yes* *No*	Select *Yes* if you want to check whether the standard deviation of the averaged sound spectra in the source and receiving rooms is too big, or not. The check is done according to the method specified in ISO 140-14:2004, A.5. If the standard deviation in a frequency band is greater than twice the theoretical expected value, then the band is marked with a yellow smiley. When the smiley is tapped, the following explanation appears: *L1 or L2: High Standard Deviation*
Receiving Room Floor Area	*0.1* to *10000 m^2*	Used to determine quality of L2 measurements
Source Room Volume	*0.1* to *100000 m^3*	Needed for report in some standards
Source Room Floor Area	*0.1* to *10000 m^2*	Used to determine quality of L1 measurements
Rubber Hammer	*Yes* *No*	NEN and NEN '06 – Impact only

Table A.11 *(Cont.)Calculation Parameters*

Parameter	Values	Comment
Floor	*Wood* *Stone*	NEN and NEN '06 – Impact, Rubber Hammer only
Cr	*–10* to *10 dB*	NEN and NEN '06 – Façade only
Traffic Type	*Road* *Rail* *Air* *Other*	NEN and NEN '06 – Façade only
CL	*–3* to *20 dB*	NEN '06 – Façade only
OILR	*–10* to *10 dB*	If you are measuring to the ASTM standard, set the dB level for the Outdoor-Indoor Level Reduction parameter here. (Only available if the Façade task is selected)
OITL	*–10* to *10 dB*	If you are measuring to the ASTM standard, set the dB level for the Outdoor-Indoor Transmission Loss parameter here. (Only available if the Façade task is selected)

Appendix B

Measurement Parameters

B.1 Building Acoustics Standards

B.1.1 Overview

For a complete overview of building acoustic standards see Table B.1 and Table B.2. For an overview of the calculated parameters see Table B.3 and Table B.4.

Table B.1 *Building Acoustics Standards – Part 1*

		International	Germany	Austria	Italy	UK	England Wales	Sweden
Measurement		ISO	DIN	ÖNORM	UNI	BS	BREW	SS
Typical Parameters		*R´ L´n*	*R L´n*	*DnT L´nT*	*Dn Ln*	*DnT L´nT*	*DnT*	*R´ L´n*
Airborne	**Lab**	10140–2*	EN 20140–3	S 5101	8270–1	EN 20140–3		EN 20140–3
	Field	140–4 16283–1	52210–1	S 5100–1	8270–4	2750–4	BREW	EN 20140–4
	Façade	140–5	52210–5	S 5100–3	8270–5	2750–5		EN 20140–5
Impact	**Lab**	10140–3*	52210–1	S 5101	8270–6	2750–6		EN 20140–6
	Field	140–7 16283–2	52210–1	S 5100–2	8270–4	2750–7		EN 20140–7
RT		3382–2	52212					
Rating	**Airborne**	717–1	52210–4	S5100–1	8270–7	5821–1, –3	BS EN 717-1	SS-ISO 717–1
	Impact	717–2	52210–4	S5100–2	8270–7	5821–2		SS-ISO 717–2

* Partially fulfilled.

Table B.2 *Building Acoustics Standards – Part 2*

		Switzerland	France	Spain		Netherlands		USA
Measurement		Sia	NF-S31	NBE	CTE	NEN	NEN'06	ASTM
Typical Parameters		*Dn T L´n T*	*DnAT LnAT*	*DnAT LnAT*	*DnT,A L´nT*	*llu lco*	*DnT,A LnT,A*	*FTL Ln*
Airborne	**Lab**		051	74-040-84/3	CTE 2008			
	Field	181	054, -057	74-040-84/4	CTE 2008	5077	5077	E336–90
	Façade	181	055, -057	74-040-84/5	CTE 2008	5077	5077	E966–90
Impact	**Lab**		-052	74-040-84/6	CTE 2008			
	Field	181	056, -057	74-040-84/7	CTE 2008	5077		E1007-11
RT						5077	5077	
Rating	**Airborne**	181	-057	NBECA-88	CTE 2008	5077	NPR 5079	E413–73 E1332–90
	Impact	181	-057	NBECA-88	CTE 2008	5077		E989

Table B.3 *Calculated Parameters – Part 1*

Standard	**ISO, DIN, ÖNORM, UNI, BS, BREW**	**SS**	**Sia(2006)**	**NF**
Basic Standards	**ISO 16283*** **ISO 140** **ISO 717**	**ISO 140** **ISO 717**	**ISO 140** **ISO 717**	**NF S31-05x**
Airborne	D Dn DnT R´ R	ISO plus:	ISO plus:	D DnT R
Calculated Parameters	Dw Dw+C Dw+Ctr Dnw Dnw+C Dnw+Ctr DnTw R´w or Rw +C +Ctr $+C_{50\text{-}3150}$ $+C_{50\text{-}5000}$ $+C_{100\text{-}5000}$ $+Ctr_{50\text{-}3150}$ $+Ctr_{100\text{-}5000}$ $+Ctr_{50\text{-}5000}$	Dw8 DnTw8 R´w8 Rw8	DnTw+C–Cv	DnATrose DnATroute Rrose Rroute
Facade	R´45° R´tr,s Dls,2m Dls,2m,n Dls,2m,nT Dtr,2m Dtr2m,n Dtr,2m,nT	See ISO	ISO plus:	DnT45° DnTtr
Calculated Parameters	Dls,2m,w Dls,2m,n,w Dls,2m,nT,w Dls,2m,nT,w+C Dls,2m,nT,w+Ctr Dtr,2m,w Dtr,2m,n,w Dtr,2m,nT,w+C Dtr,2m,nT,w+Ctr R´45°w or R´tr,s,w +C +Ctr $+C_{50\text{-}3150}$ $+C_{50\text{-}5000}$ $+C_{100\text{-}5000}$ $+Ctr_{50\text{-}3150}$ $+Ctr_{100\text{-}5000}$ $+Ctr_{50\text{-}5000}$		D45°nT Dls,2m,nT,w+C–Cv Dtr,2m,nT,w+C–Cv D45°nT,w+Ctr–Cv	DnATroute45° DnATroute
Impact	L´nT Ln	ISO plus:	See ISO	LnT Ln
Calculated Parameters	L´nw L´nTw or Lnw +Ci $+Ci_{50\text{-}2500}$	L´nw8 L´nTw8 Lnw8		LnAT LnA

* ISO 16283: Additional low-frequency measurement procedure for low frequencies in small rooms. The L_{Corner} and L_{LF} results are used for calculating and displaying the final results.

Table B.4 *Calculated Parameters – Part 2*

Standard	NBE	CTE	NEN	NEN'06	ASTM
Basic Standards	**ISO 140**	**ISO 140**	**NEN 5077**	**NEN 5077-2006**	**ASTM E336, 1007, E966, E1332**
Airborne	ISO plus:	ISO plus:	DnT	DnT	NR NNR FTL
Calculated Parameters	DA DnAT RA R´A	DA DnA DnT,A RA R´A	Ilu Ilu;k	DnT,A DnT,A,k	NIC NNIC FSTC
Facade	ISO plus:	ISO plus:	Gi	Gi	OILR OITL
Calculated Parameters	R´A45° Dls,2m,nAT Dtr,2m,nAT Dtr,2m,A Dls,2m,A Dls,2m,n,w+C Dls,2m,n,w+Ctr	R´45°A R´45°Aav R´45°Aef R´45°Atr R´A R´Atr D2m,A D2m,Aav D2m,Aef D2m,Atr D2m,n,A D2m,n,Aav D2m,n,Aef D2m,n,Atr D2m,nT,A D2m,nT,Aav D2m,nT,Aef D2m,nT,Atr Dls,2m,n,w+C Dls,2m,n,w+Ctr	G_A $G_{A;K}$	G_A $G_{A;K}$	OITC
Impact	ISO plus:	See ISO	LnT		LnT Ln
Calculated Parameters	LnAT LnA		Ico		IIC NISR

Index

Numerics

2-channel Measurements 14
6 dB Rule 14

A

Adding Image to Current Measurement 66
Adding Images to a Measurement 66
Airborne Sound Insulation 3, 7
Airborne Sound Insulation Measurements
  Setup 4
Airborne Task 19
Annotations 65
  Paperclip Icon 20
Annotations and Sound Recording 65
Annotations Icon 20
Annotations on Measurement 66
Automated Sequence
  Combine Parallel and Serial Measurements 41
Automatic Increment 37
Automatic Save 37
Autorange 82
Auxiliary Parameters
  in Reverberation Time Software 47
Averaging
  Spatial 6

B

B2 4
Background Noise
  Correction 5
Background Sound Level Measurement B2 4
Bandwidth and Frequency Range 28
Building Acoustics
  Partitions 5
  Tasks 3
Building Acoustics Defined 3
Building Acoustics Measurement Procedure 6
Building Acoustics Project Template 26
Building Acoustics Software 17
  Navigating 17
Building Acoustics Software BZ-7228 17
Building Acoustics Standards 6, 95
BZ-7228 Building Acoustics Software 17

C

Calculated Parameters 97, 98
Calculations 59
Calculations Parameters 92
Calculations Tab 59
Changing Function 34
Changing the Number of Sources
  and Microphone Positions 37
Combine Parallel and Serial Measurements
  in an Automated Sequence 41
Combined 29
Combined Tasks and Measurements 13
Commentary Icon 20
Controlling
  the Reverberation Time Measurement 33, 43
Controlling Dual-channel Measurements
  (Type 2270 Only) 54
Controlling the Measurement 33
Conventions Used in this Manual 1
Correction Filters 72
Correction for Background Noise 5
Creating a New Project 64

D

Decay 73
Decay Graph 47
Decay Graphs in Reverberation Time Software 47
Decay Tab 44, 47
Decay Tab in Reverberation Time Software 47
Decay View (T2) 23
Detectors 72
Display Reverberation Time 46
Displaying Results 58

Displaying the Results
in Reverberation Time Software 44
Dual-channel Measurements (Type 2270 Only) 53

E

Example of a Planned Measurement Task 34
Example of a Serial Measurement 39
Example of an Unplanned Measurement 38
Exporting 67

F

Façade Sound Insulation 3, 11
Façade Sound Insulation Measurement
Setup 12
Façade Task 19
Field Measurements 5
Field vs. Laboratory Measurements 5
Frequency Range 84
Frequency Weighting Parameters 84
Function 34
Function Selector 19

G

Generator for L1 and L2 Parameters 88
Generator for T2 Parameters 89
Generator Setup for L1 and L2 29
Generator Setup for T2 43
Geometry 33

H

Hardware Setup 15
How to Use this Manual
Beginners 2
Experienced Users 2

I

Icon
Annotations 20
Commentary 20
PC 20
Images 66
Impact Sound Level 3, 12
Impact Sound Level Measurement
Setup 13
Impact Task 19
Impulsive Excitation Method 10
Impulsive Method 43
Increment 37
Input 82, 83
Input Parameters 82
Input Selections 27
Input Selections (Type 2270 only) 53
Interrupted Noise Method 9, 42
Introduction 1, 3
Introduction to Building Acoustics 17
ISO 140 18

L

L1 4
L1 and L2 Simultaneously
(Type 2270 Only) 54
L1&L2 Function 17
L2 4
Laboratory Measurements 5
LAN 20
Level Measurement Mode 29
Level Measurements (L1, L2 and B2) 25
Level Trigger Parameters 87
Logged Broadband (100 ms) Parameters 87
Logged Spectrum Parameters 87
Low Frequency Measurements 41
L_{Zeq} 7
LZF 46

M

Manual Selection of Measurement Position 37, 39
Markers 87
Measure L1 and L2 Simultaneously
(Type 2270 Only) 54
Measured Standards
ASTM 6, 18
BREW 6, 18
BS 6, 18
CTE 6, 18
DIN 6, 18
ISO 6
ISO 16283 18
ISO 16283LF 18
NBE 6, 18
NEN 6, 18
NEN'06 ..... 6, 18
NF 6, 18
ÖNORM 6, 18
Sia 6
Sia (2006) 18
SS 6, 18
UNI 6, 18
Measurement Control L1, L2 and B2 Parameters 85
Measurement Control Setup – L1, L2 and B2 28
Measurement Control T2 Parameters 86
Measurement Parameters 95
Measurement Procedure 6

Measurements
Field ... 5
Laboratory ... 5
Receiving Room (B2) ... 8
Receiving Room (L2) ... 7
Reverberation Time (T2) ... 8
Source Room (L1) ... 7
Measuring
Two Positions Simultaneously ... 58
Measuring Two Positions Simultaneously ... 58

N

Navigating Building Acoustics Software ... 17
New Project ... 64

O

Overview ... 58
Overview (L1, L2, L1&L2, B2 and T2) ... 21
Overview of Building Acoustics Standards ... 95
Overview Tab ... 44, 58
Overview Tab (Type 2270) ... 55
Overview Tab in Reverberation Time Software ... 44

P

Paperclip ... 20
Parallel ... 29
Parameters
Automatic Save ... 29, 42, 43
Autorange (Type 2270 Only) ... 53
Build-up Time ... 30
Calculate Using ... 31
CL ... 32
Correct for Background Noise ... 31
Cr ... 32
Ensemble Averaging ... 31
Escape Time ... 30
Excitation ... 42
Floor ... 32
Generator Type ... 29
Increment ... 29, 42
Input for B2 (Type 2270 Only) ... 53
Input for L1 (Type 2270 Only) ... 53
Input for L2 (Type 2270 Only) ... 53
Input for T2 (Type 2270 Only) ... 53
L1 Check 6 dB Rule ... 32
L1, L2 Check Std. Deviation ... 32
L1/L2 - No of Micr. Pos. per Source ... 29
Level Measurement Mode ... 29
Max Decay Time ... 42
Measure L1 and L2 (Type 2270 Only) ... 53
No. of Micr. Pos per Source ... 42
No. of Sources (Positions) ... 29
No. of Sources Positions ... 42
Noise Type ... 30
OILR Correction ... 32
OITL Correction ... 32
Partition Area S ... 33
Planned Measurement ... 29, 41
Preset Time ... 29
Range Setting (Type 2270 Only) ... 54
Receiv. Room Floor Area ... 32
Receiv. Room Volume V ... 31
Recording Quality ... 30
Reolution ... 30
Rubber Hammer ... 32
Sound Recording ... 30
Sound Source ... 30
Stone ... 32
T20 ... 31
T30 ... 31
Traffic Type ... 32
Trigger Level ... 43
Trigger Repeat ... 43
Wood ... 32
Partition Area ... 33
Partitions ... 5
PC Icon ... 20
Periodic Reports ... 87
Planned Measurement Task
Example ... 34
Planned Measurements ... 25, 43
Planned vs. Unplanned Measurements ... 25
Post-processing ... 67
Project Annotations ... 65
Project Template Bar ... 18

Q

Quality Indicators ... 61

R

Range Setting ... 83
Parameters
Level ... 30
Ready for First Measurement ... 35, 51
Ready for First Measurement (Dual-channel) ... 55
Rear Socket ... 83
Receiv. Room Vol. V2 ... 33
Receiving Room ... 4
Receiving Room (B2) Measurements ... 8
Receiving Room (L2) Measurements ... 7
Reporting ... 67
Results
Displaying ... 58
Results Link ... 58
Re-using Data ... 64
Re-using Data from an Existing Project ... 64
Reverberation Time (T2) Measurements ... 8
Reverberation Time Measurement (T2) ... 4
Reverberation Time Measurements (T2) ... 41

Reverberation Time Software
Decay Tab ... 47
Overview Tab ... 44
Spectrum Tab ... 45

S

Save ... 37
Serial ... 29
Serial Measurement
Example ... 39
Serial Measurements ... 14
Setting the Bandwidth and Frequency Range ... 28
Setting the Relevant Standard and Task ... 27
Setting up the Instrument
(for Dual-channel Measurements) ... 53
(for Single-channel Measurements) ... 26
For T2 Measurements ... 41
Setup Calculations ... 31
Setup for Sound Recording ... 30
Setup Parameters ... 81
Simultaneously ... 19, 24, 29, 53, 54, 55
Simultaneously (in the Same Room) ... 58
Single-channel Measurements ... 26
Smiley Explanation ... 64
Software
Building Acoustics ... 17
Sound Field Correction ... 82, 83
Sound Insulation
Airborne ... 7
Sound Level Measurement L1 ... 4
Sound Level Measurement L2 ... 4
Sound Recording ... 43, 67
Setup ... 30
Sound Recording Parameters ... 87
Source Room ... 4
Source Room (L1) Measurements ... 7
Source Room Floor Area ... 33
Source Room Vol. V1 ... 33
Sources and Microphone Positions ... 37
Spatial Averaging ... 6
Specifications ... 69
Type 2250/2270 Platform ... 70
Spectrum Graph ... 45
Spectrum Graphs in
Reverberation Time Software ... 45
Spectrum Parameters – Measurement Display ... 36
Spectrum Parameters – Result Display ... 49, 57
Spectrum Tab ... 44
Spectrum Tab (Type 2270) ... 55
Spectrum Table ... 63
Spectrum View (L1, L2, L1&L2 and B2) ... 22
Spectrum View (T2) ... 23
SpectrumTab in Reverberation Time Software ... 45
Standard ... 84
Standard Selector ... 18
Standards ... 6
Status Field ... 20
System Overview ... 15
System Overview Diagram ... 15

T

T2 ... 4
T2 Measurement Mode ... 42
T2 Measurements ... 41
T2 Selector ... 44
T20 ... 46
T20@Pos ... 46
T30 ... 46
T30@Pos ... 46
Tab
Calculations ... 59
Decay ... 44
Decay (T2) ... 23
Overview ... 21, 44, 58
Spectrum ... 22
Spectrum (T2) ... 23
Tab Overview (Type 2270) ... 55
Tab Spectrum ... 44
Tab Spectrum (Type 2270) ... 55
Task Selector ... 19
Tasks in Building Acoustics ... 3
Things to Remember ... 24
Traffic Noise ... 11
Trial Measurement ... 25
Typical Setup for
Airborne Sound Insulation Measurements ... 4

U

Unplanned Measurement ... 25
Example ... 38
Unplanned Measurements ... 43

W

Welcome ... 3
What is a Building Acoustics Project? ... 17
Wi-Fi ... 20
Windscreen Auto Detect ... 83
Windscreen Correction Parameter ... 83

BE 1799 – 11

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